A STUDY OF RISK MANAGEMENT IN DEALING WITH CONTRACTS IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

There is a consensus that the construction industry is subject to greater risk and uncertainty than other industries. Many studies of construction management and contract management have looked at risk management in major construction projects. However, most of these studies focussed on the client (buyer) rather than the contractor (seller), and most dealt with the engineering management of construction work rather than the managerial decision making process involved.

This study concerns risk management by decision makers in contracting firms in the British construction industry. The purpose of this study is to examine how construction contractors perceive their decision making process in terms of risk perception and management.

The study has gathered data and analysed it to examine four main hypotheses. Chapter One provides an overview of the literature on how individual buyers and business executives deal with perceived risk in general purchasing. Chapter Two examines the underlying theory of risk management in the construction industry to understand the principles and processes of risk management. Chapter Three describes the construction industry. Chapter Four introduces models of organisational buying behaviour and construction processes. Chapter Five demonstrates that the tendering stage constitutes an important area where the contractor applies risk management strategies. Chapter Six provides a discussion of the contract commitment stage.

After considering relevant factors, 210 construction contractors operating in Britain were identified. A questionnaire, with a covering letter, was mailed directly to the Managing Director of the contractors included in the sample. From the sample, 101 sample contractors replied to yield a total of 76 useful responses. The 36.2% response rate was considered high

enough to provide the data required for the purposes of this study. The research design and methods used for data collection and analysis are dealt with in Chapter Seven.

The analysis of the data mainly has been presented in Chapter Eight. The results show that all the four hypotheses have been supported. Chapter Nine summarises the findings of the study with recommendations for further research. The results of the study indicate that:

Construction companies perceive risks in their contracting process, and some situational factors affect the risk perception. Although risk analysis is relevant to the construction industry, rigorous analysis techniques such as sensitivity analysis, probability analysis, decision tree analysis, simulation approach, etc. are not widely applied in the contracting process, instead the more traditional techniques are still favoured for risk analysis.

The tendering stage and the commitment stage are the critical stages for contract decision making. The tendering stage is the most important phase for applying risk management primarily through an effective bidding/negotiating approach. However, the final success of a construction project depends on the contractor's ability to manage the risk factors involved in the commitment stage. An inability to manage becomes a major source of risk in this stage.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACE	Association of Consulting Engineers
AR	Acceptable Range
CASEC	Committee of Associations of Specialist Engineering Contractors
CASPAR	Computer Aided Simulation for Project Appraisal and Review
CE	Cost Estimate
CIRIA	Construction Industry Research and Information Association
CPS	Construction Project Simulator
CSO	Central Statistical Office
DMU	Decision-making Unit
DoE	Department of the Environment
DTI	Department of Trade and Industry
EUV	Expected Utility Value
FASS	Federation of Associations of Specialists and Subcontractors
HMSO	Her Majesty's Stationery Office
HRM	Human Resources Management
ICE	Institution of Civil Engineers
JCT	Joint Contracts Tribunal
LAR	Lower Limit of Acceptable Range
LCE	Lower Limit of Cost Estimate
NEC	New Engineering Contract
NEDO	National Economic Development Office
NFBTE	National Federation of Building Trades Employers
NJCC	National Joint Consultative Council of Architects, Quantity Surveyors and Builders
OPBID	Optimum Bid
PBS/GSA	Public Buildings Service of the General Service Administration
PC	Personal Computer
PERM	Project Estimate and Risk Monitor
RIBA	Royal Institute of British Architects
RICS	Royal Institution of Chartered Surveyors

SERC	Science and Engineering Research Council
SCERT	Synergistic Contingency Evaluation and Review Technique
SPSS	Statistical Package for the Social Sciences
TMT	Top-management Team
TQM	Total Quality Management
UAR	Upper Limit of Acceptable Range
UCE	Upper Limit of Cost Estimate
VAT	Value-added Tax

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DECLARATION

No portion of the work referred to in this study has been submitted in support of an application for another degree or qualification in this or any university or any other institution of learning.

INTRODUCTION

0.1. GENERAL BACKGROUND

The development and execution of a construction project from the conceptual stage through completion and use, whether it newly built or refurbishment, will generally involve a complex and time consuming decision making process. This process is usually difficult and uncertain, and is often exacerbated by the conflicting objectives of the parties involved.

Many past studies of construction management (NEDO, 1974; NEDO, 1975; Roberts, 1980; Adrian, 1981; Maher, 1982; Cushman et al, 1983; Pilcher, 1985; Calvert, 1986; NEDO, 1991), and contract management (Porter, 1981; CIRIA REPORT 85, 1982; CIRIA REPORT 100, 1983; Perry, 1985) have been undertaken. Research has also looked into the risk management on major projects (Healy, 1981; Hayes et al, 1986; Orman, 1991; Ward et al, 1991). Since the client/customer initiates the whole construction process, maintains strategic control throughout the project, and is one of the most important participants in the construction industry, most of these studies scrutinise the problems in view of the client (buyer) rather than the contractor (seller), and most dealt with how construction work was managed as an engineering project rather than a managerial decision making process.

Decision making is problematic because decisions are made by and about people, involve the future, are concerned with change and use imperfect information and knowledge (Langford et al, 1995). Decision making can have a substantial impact on the success of business organisations (Crouch and Wilson, 1982; Peters and Waterman, 1982). This is because, in conventional decision theory formulations, business decisions involve a trade-off between risk and expected return, and every managerial situation involves decisions about risk and reward (March and Shapira, 1988). Unfortunately, the construction industry has a image of unsophisticated decision making (Langford et al, 1995). The importance of identification or perception and management of risk in decision making, in terms of the success of the business organisation, cannot be over-emphasised.

However, risk is a subjective concept (Swalm, 1966; Cox and Rich, 1967; Mao, 1970; Rapoport and Wallsten, 1972; Moore and Thomas, 1973; Cooley, 1977) so that the final decision is normally based not only on the decision maker's perception of the advantages, disadvantages and risks, but also on their attitude towards risk.

Considerable research has been done on the perception and management of risk by decision makers. However, most of these studies dealt with individual decision makers in consumer buying involving relatively small value transactions (Arndt, 1967; Cunningham, 1967; Barach, 1969; woodruff, 1972; Taylor, 1974; Hugstad et al, 1987). Virtually all are concerned with buyers. Similarly, research on industrial buying behaviour has emphasised the role of the 'buying centre' rather than the 'selling centre' (Wind, 1970; Cardozo and Cagley, 1971; Newall, 1977; Crow et al, 1980; Jackson, 1980; Johnston and Bonoma, 1981; Bonoma, 1982; Henthorne, 1993). These studies describe perception and management of risk in both individual consumer and organisation buyer. One interesting aspect is their disinterest in the sellers' perception and management of their risks. Little attention has been given to the behaviour of sellers. The implication of past research is that only buyers perceive risk and develop strategies to manage it.

This study does not share this one-sided view and will focus on sellers and their management of risk. Contractors as sellers in the construction business transaction can also be at risk in their contract decision making process, and this can be managed if risks are identified and evaluated in a systematic way by applying appropriate risk management methods.

The justification for choosing the construction industry is based on its importance to national economic development, and its association with the public sector because of the author's 'government official' background.

The overall structure of the study is illustrated in Figure 0.1.

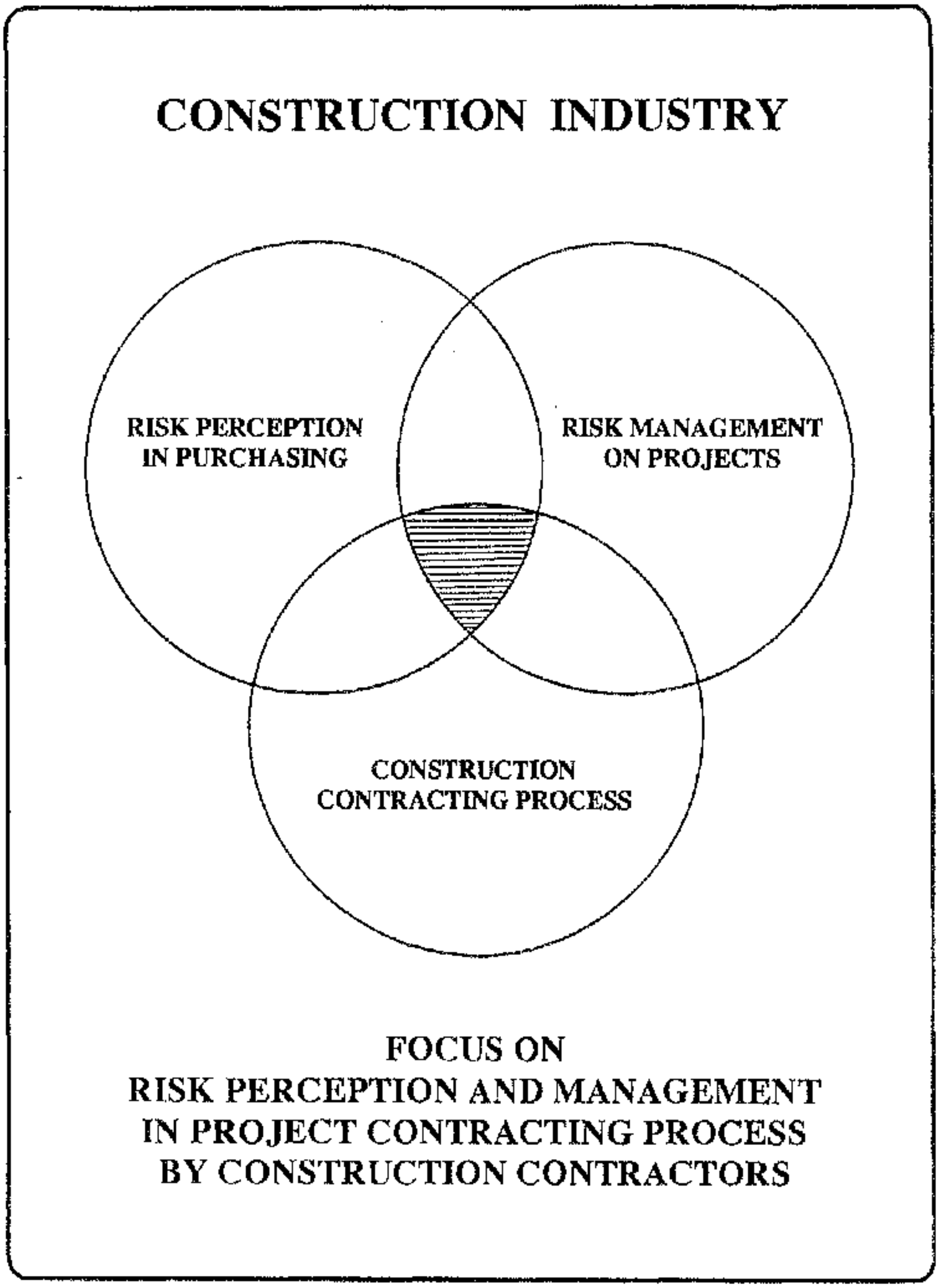
0.2. PURPOSE AND OBJECTIVES OF THE STUDY

There is a consensus that the construction industry is subject to more risk and uncertainty than other industries (Lifson and Shaifer, 1982). The main purpose of this study is to challenge the assumption that only buyers perceive and manage risk in their decision making process particularly in the context of the construction industry, and to demonstrate that perception and management of risk in decision making is not an exclusive preserve of buyers alone, but that it is a common phenomenon which affects contractors - the sellers in the construction industry as well.

Basically, the contract decision agreement is a buying/selling decision and involves considerable risk. By investigating how the contractors perceive and manage risk in dealing with contracts, this study has the following objectives:

1) To investigate the types of the risks perceived by contractors in their contract decision making process.
2) To investigate the factors which affect the risk perception.
3) To investigate how risk analysis techniques are used in the contracting process.

Figure 0.1. Structure of the Study



4) To investigate the risk management methods employed in the different decision stages in contracting process, i.e. pre-tendering stage, tendering stage, negotiation stage, and commitment stage.

0.3. HYPOTHESES

This study examines how construction contractors interprete their contract decision making process in terms of risk perception and management. The study gathered data and analysed it to examine four main hypotheses based on findings reported in other research. The formulation of the hypotheses and the elaboration of the sub-hypotheses are discussed in the following chapters. A brief description of the main hypotheses follows.

Since buyers perceive risk and develop strategies to manage risk, we also expected that sellers, represented by construction companies, also perceive and manage risk in their decision making about contract. This area has not been investigated in previous research. We hypothesised that -

H1: Construction companies perceive risks in their contracting process, however the level of perceived risk is determined by situational factors.

The second hypothesis is concerned with acceptance and application of risk analysis in the decision making process of the construction industry. Many risks and uncertainties are quantifiable in terms of their effect on cost or time or revenue. Risk analysis is the process used to quantify the effects on a construction projects of the risks that have been identified. In the past, many techniques of risk analysis such as sensitivity analysis, probability contours, probability distributions, decision trees, Bayesian analysis, and simulation approach have been extensively developed and claimed to be useful by their developers. Although the risk analysis concept is relevant in the construction industry and the level of awareness of these analysis techniques is high (Simister, 1994), the difficulty of treatment of correlated variables makes it difficult for risk analysis to be effective in the contract decision making. Specifically, we hypothesised that -

H2: Rigorous risk analysis techniques are not widely applied in the contracting process of the construction industry, instead the more traditional techniques are still favoured for risk analysis.

The industrial buying decision has been suggested to evolve through different procedural stages (Robinson et al, 1967; Webster and Wind, 1972; Wind, 1978; Parkinson and Baker, 1986). Therefore, we predicted the buying decision stages are relevant in the construction industry, and a standard construction contract evolves through phases similar to those in more general industrial buying. In addition, we expected that risks in construction contracts are spread between the decision phases through which a contract decision process evolves.

The tendering or bidding stage and the commitment stage are identified as the critical stages in a contract decision making. To be effective the contractor must analyse the critical stages in order to manage the inherent risks. In other words, effective management of risks in the construction industry must manage risks in these critical stages. Also we realised that the success of the construction project, particularly the success of the commitment stage, depends on the contractor's ability to manage many sources of risks involved. A lack of that ability to manage becomes a major source of risk itself. Together, these suggest a more broadly based approach to risk management in construction contracts. Therefore, we hypothesised that -

H3: The tendering stage is the most important phase for applying risk management primarily through an effective bidding/negotiating approach.

H4: The successful execution of the construction work largely depends on the contractor's resources and management ability. Hence 'Management Risk' is the main risk in the contract commitment stage.

0.4. RESEARCH METHODOLOGY

To achieve the research objectives the following methodology has been used in this study.

Literature Review

A survey of existing knowledge and literature about: the perception and management of risk in buying, risk management in construction industry, construction industry itself, contract management, and construction management has been undertaken. Pooling the background information received from these areas allows some new concepts to be introduced. The purpose of the review is to provide the base for the general hypotheses.

Mail Survey

A structured postal questionnaire, supplemented by interviews with eight contractors, was the survey method this study adopted. Twenty (20) companies from Glasgow and Edinburgh were used in piloting the questionnaire. All the selected companies were approached for their assistance and those who were willing were each visited. Their results and responses were used to refine the questionnaire.

Two published sources were used as the sampling frames for the postal survey. The first source was *Kompass* (1993/1994), the second source was Dun and Bradstreet's Guide to *Key British Enterprises* (1993). Two hundred and ten (210) companies have been selected. This sample size is considered large enough to provide a useful response. In September 1993, the questionnaire and a cover letter was mailed to the Managing Director of each of the company in the sample. The letter introduced the sponsor, explained its purpose, and assured confidentiality. Each company was asked to base its response on just one contract of at least one million pounds completed in 1991-1993. One hundred and one (101) companies replied to the survey to yield seventy six (76) useful responses. In view of the questionnaire's being mailed, and their length, the thirty six point two percent (36.2%) usable replies was considered high enough to provide the required data for the purpose of this study.

The data analysis has been undertaken using computer method. This allowed a grouping of questionnaire answers into contingency tables, from which further analysis was carried out. The results show that the hypotheses are supported.

0.5. PLAN OF THE STUDY

Finally, the study consists of an introduction and nine chapters. The introduction describes the study's general background, the purpose and objectives, the hypotheses, the research methodology, and the plan of the study. Thus gives a general idea about the study's origin, nature, and coverage.

Chapter One gives an overview of the literature on how individual buyers and business executives deal with perceived risk in their buying process. The review has concentrated on the definition of risk, its subjective nature, and the factors which affect risk perception. Past research has described how decision makers manage their perceived risk in purchasing. From the review, it is shown that little attention has been given to the impact or risk on behaviour of the sellers.

Chapter Two examines the underlying theory of risk management in the construction industry with a view to understanding the principles and processes of risk management. From existing literature, the state of knowledge about various risk analysis techniques is outlined. This chapter also discusses the basic principles of risk allocation.

Chapter Three describes the construction industry. It examines the nature of the industry in its three basic facets: what it does, the participants, and the general features of its products. It also provides a general discussion of the industry's importance to the economy. It also reviews the types of construction contracts used.

Chapter Four introduces models of organisational buying behaviour and construction processes. This chapter shows that the buying process evolves through phases, and that a standard construction contract evolves through phases similar to those in more general buying. This suggests that risk in construction contracts is spread throughout the decision making process. Construction companies therefore need to analyse these phases to identify risk areas and the most appropriate risk management strategy to apply. This chapter also describes the concept of supply chain management.

Chapter Five demonstrates that the tendering stage constitutes an important area where the contractor can apply risk management strategies. In addition to the details of the tender and its risk implications, this chapter also discusses some aspects of bidding theory and bidding models.

Chapter Six offers a broad discussion in the contract commitment stage. There are different forms of construction contract, and various factors affecting its successful completion. In the contract commitment stage, the main challenge the construction company faces is 'management risk', which can not be completely covered by a successful bid.

Chapter Seven deals with the research design and methods used for data collection and analysis, and problems encountered during the study.

Chapter Eight presents the results of analysis, based on the responses to the survey of companies in the British construction industry. The analysis shows that the hypotheses have been supported.

Chapter Nine summarises the findings of the study with recommendations for further research.

0.6. CONCLUDING REMARK

This study draws together a number of previously unrelated streams of research and challenges some of their conclusions. It also highlights opportunities for further theoretical and empirical work.

Moreover, the analysis presented advances the understanding of risk management for contractors, and provides important insights to help in developing a better understanding of the management in the construction industry. The results should lead to an improvement in managing risk.

CHAPTER ONE: PERCEPTION AND MANAGEMENT OF RISK

1.1. INTRODUCTION

This chapter reviews the literature mainly on perceived risk. It does not include literature on the construction industry because past research on behaviour towards risk of buyers (clients) and sellers (contractors) are scanty. Nevertheless, general concepts of risk management systems used in the construction industry are described in Chapter Two.

Risk means different things to different people in different situations. This review looks at the literature on how individual customers perceive risk. The review has concentrated on the issues which are associated with the definition of risk, its subjective nature, and the factors which appear to be responsible for this subjectivity. Then, the review has demonstrated how the decision maker manages his perceived risk in buying situation. A review of the literature which deals with relatively simple risks is useful in explaining the concept of risk and its effects on the decisions.

1.2. WHAT IS RISK

This study begins with *the Oxford English Dictionary* definition of risk. The noun is defined as hazard, danger, exposure to mischance or peril, and further as the chance or hazard of commercial loss. The verb 'to risk' is to hazard something, to be exposed to the chance of some injury or loss (Oxford University, 1961). Risk is all around us. It would be very hard to find many activities not influenced by risk and uncertainty. Businesses face uncertainty constantly. Decisions on new product launches, major capital investment programmes as well as the outcomes of construction projects are very difficult to predict accurately.

Risk refers to a lack of predictability about outcomes in decision making or planning. Risks are usually considered as uncertain future events (Barnes, 1983). However, the concept of risk eludes precise definition although it has been frequently studied. There are several definitions of risk because different researchers have their own approaches studying risk. March and Shapira (1987:1404) expressed their view in defining risk as:

> "Risk is most commonly conceived as reflecting variation in the distribution of possible outcomes, their likelihoods, and their subjective values."

Libby and Fishburn (1977:279) defined the risk as:

> "Risk has been conceptualised in many ways, usually involving dispersion of outcomes and/or the failure to obtain a certain level of return."

Risk can be interpreted as a lack of predictability about potential outcomes or consequences (March, 1978). Risk is expressed as a function of the uncertainty associated with all future events as yet unmaterialised (Yeo, 1995). Risk is also related to the probability of loss or probability of gain (Slovic, 1972; Al-Bahar and Crandall, 1990; Yeo, 1995). These definitions can be summarised:

* both uncertainty and the results of uncertainty;
* uncertainty of loss;
* the difference between expectations and realisations;
* the possible variance of returns;
* the probability of an unfortunate occurrence;

* the probability of not receiving what is expected;

In their *A Theory of Risk,* Pollatsek and Tversky (1970:541) recognised the problems of defining risk and maintained that -

> "No general agreement concerning the nature of risk has been reached."

1.2.1. Risk and Uncertainty

The fundamental notion of risk and uncertainty is variability. Thus, some future event is risky and uncertain because of the variation in possible outcomes. To the extent that variation of possible outcomes is reduced the accuracy of prediction is increased and uncertainty and risk reduced. This raises a question of whether risk and uncertainty are synonymous. Weston and Brigham (1979:251) have acknowledged this distinction between terms, but noted:

> "We do not make this distinction; risk and uncertainty are used synonymously."

The view of Wilson and Crouch (1987:267) is:

> "The concept of risk and the notion of uncertainty are closely related."

Jackson (1980) simply pointed out that risk means both uncertainty and the result of uncertainty. Cooley (1977), Taylor (1974), Nicosia (1969), Hertz (1968), Bauer (1967) and Green (1963) also made no distinction between risk and uncertainty. In these studies, risk and uncertainty are synonymous.

1.2.2. The Distinction between Risk and Uncertainty

Although some studies used risk and uncertainty synonymously, others have distinguished between them. The distinct notions of risk and uncertainty have been widely analysed by economists, insurance theorists, decision theorists, and philosophers. Knight (1933) was more concerned with the economic aspects of risk and uncertainty. He considered the problem by first defining three types of probabilities:

1) *a priori*, which is deducible or obvious from the nature of the situation, e.g., the probability of getting an ace when throwing a six sided dice.
2) statistical, which can be arrived at inductively by examining a large number of observations, e.g., the probability that a man age 20 will die within the year.
3) estimate or judgment, which can not be determined objectively but can only be intuitive, e.g., the probability that a new restaurant will be profitable.

All three types deal with uncertainty, but the first two consider measurable uncertainty while the third looks at unmeasurable uncertainty. Measurable uncertainty is an objective phenomenon he called 'risk' and an unmeasurable one is a subjective idea which he called 'uncertainty'. Knight (1933:233) then elaborated this distinction as follows:

> "The practical difference between the two categories, risk and uncertainty, is that in the former the distribution of the outcome in a group of instances is known (either through calculation *a priori* or from statistics of past experience), while in the case of uncertainty, this is not

true, the reason being in general that it is impossible to form a group of instances because the situation dealt with is in a high degree unique."

Van Horne (1977:115) has argued that risk is distinct from uncertainty:

"The distinction between risk and uncertainty is that risk involves situations in which the probabilities of a particular event occurring are known; whereas with uncertainty, these probabilities are not known."

The view of Newcombe et al (1990:39) is:

"Strictly, risks are events, the probabilities of the occurrences of which are statistically predictable; uncertainties are unpredictable."

Duncan (1972:318) came to the conclusion that -

"In uncertain situations, there is less predictability with respect to the outcome of events than under conditions of risk."

Knight (1933) also noted the objective-subjective distinction. He maintained that risk denotes the use of objective probability distributions, while uncertainty applies to the use of subjective probability estimates. Baker (1975) has also supported the distinction. However, unlike Knight, Baker considered questions of rationality and utility preference. The objectivity of assigned probability distributions under risk is debatable, and requires research to enable a definitive statement. Anyone familiar with business decisions would agree that most business decisions are made on the basis of subjective probability estimates. Hill and Hillier (1977:83) have described business decision making:

> "In a business environment, decisions are usually made under conditions of uncertainty rather than risk because it is difficult to anticipate future market and environmental developments and to relate these to events in the past in an objective manner."

Accepting these distinctions implies that business decisions are not risky, and only uncertainty exists in business decisions. However, it is possible for decision maker to assign a subjective probability to an uncertainty (Fellows et al, 1991). This is also consistent with the views of Hertz who observed that investment decisions still go wrong in spite of the computers and evaluation techniques. Hertz (1979:178) has stated:

> "As every executive and economist knows, the estimates used in making the advanced calculations are just that - estimates."

Commonly, the term 'risk' is applied to quantifiable aspects of uncertainty, but nonquantifiable uncertainty continues to exist in risk analysis. As knowledge increases, in conjunction with the amount and detail of statistical data, areas of uncertainty are progressively converted to areas of risk (Fellows et al, 1991). In most cases the decision makers are neither completely ignorant or certain of the probabilities of future events.

Many decisions in the construction industry are unique and non-repetitive. This means that decisions often require 'non-statistical' or subjective probability assessments. These are consistent and coherent with the laws of probability in order to represent the uncertainty recognised (Hertz and Thomas, 1983). This shows that the distinction between risk and uncertainty is of limited practical value. Hill and Hillier (1977:83) have stated:

> "In practice, both the terms uncertainty and risk are usually considered to be interchangeable."

Yeo (1995) also pointed out that the terms risk and uncertainty are used interchangeably. Although in practice, the distinction between risk and uncertainty is not critical, the concept of risk must strictly reflect reality. For example, the change of a government's policies may not be a quantifiable risk, but it is an uncertainty to be considered. While recognising the distinction made in some studies there is no consensus supporting those views. The terms 'risk' and 'uncertainty' will be used interchangeably in this thesis.

1.2.3. Risk Defined

A common view of risk is that it refers to a lack of predictability about outcomes or consequences in a management decision. However, some have noted that the term risk is applied primarily to negative outcomes (Baird and Thomas, 1985; Levitt and March, 1988). Basically, risk comprises following essential elements:

* the number of possible outcomes;
* the value of each outcome;
* the probability of the occurrence of each outcome;

But, first of all, it is essential to distinguish between a statistical concept of risk, and the operational concept of risk. The statistical concept of risk embodies statistical measurability, and is defined in terms of rationally assigned probabilities to the outcome of events. The operational concept of risk, on the other hand, is defined in terms of personal preferences, and is associated with the perception of the person or company making a decision in a given context or situation. Because operational risk is associated with the perception of the decision maker, it is normally referred to as 'perceived risk', and is associated with the concept of loss. This view is expressed in Webster's definition (1979:32) of perceived risk as:

> "A function of the buyer's level of uncertainty and the seriousness of the consequences associated with various decision outcomes."

He went on to state that there are two types of risk:

1) product performance risk associated with the extent to which the product meets the buyer's expectations with respect to actual performance;
2) psychosocial risk which deals with the way other relevant persons react to the decision, as well as how the buyer himself feels about the outcome.

As far as the individual consumer is concerned, perceived risk is primarily a matter of whether they will suffer a significant social or economic loss if their decision leads to a loss. Put another way, the individual's perceived risk is identical with their perceived chances of loss in a particular decision. Peter and Ryan (1976:185) supported the loss concept of operational risk and defined perceived risk as:

> "The expectation of losses associated with purchases."

Pilcher (1992:254) also supported the loss concept of risk in his book about construction management. He maintained that -

> "Risk and cost tend to be synonymous. A failure by a contractor to manage successfully the risk in a project will certainly increase the cost."

The association of perceived risk with expected losses has been supported by a number of studies. Pruitt (1962), Slovic and Lichtenstein (1968) all defined risk in terms of probabilities associated with the amounts liable to loss. Outfin (1992), Joy and Barron (1974) also defined risk as the probability of loss, failure or misfortune. Slovic (1972) provided supporting evidence. After a review of studies of risk, including his own, Slovic observed that subjects in these studies were making decisions on the basis of minimising possible losses or maximising possible gains. Slovic (1972:794) concluded that -

> "Riskiness is more likely to be determined by the probability of loss and the amount of loss."

In other review articles, Slovic (1967) and Payne (1975) came to the same conclusion, that perceived risk was highly associated with the probability of loss. Collectively, therefore, these studies support the conceptualisation of risk as the probability of loss, or failure to achieve a certain goal. From this review we can therefore define perceived risk simply as:

> "What a person perceives he may lose in a given situation as a result of his action."

1.3. SUBJECTIVITY OF PERCEIVED RISK

We have defined perceived risk in Sub-section 1.2.3., we can consider its subjective nature now. Although the operational risk is associated with the chance of loss or gain, this perception tends to be highly subjective. For example, in their review of literature on psychological risk-taking behaviour, Rapoport and Wallsten (1972:145) stated:

> "In summary, it seems that the concept of risk is psychologically meaningful but highly elusive. Expected value, variance, number of independent plays, probabilities of winning and losing, ... all affect the perceived riskiness in one way or another, making the development of satisfactory theory of risk a very difficult task."

They concluded that the concept of risk appeared to be highly 'idiosyncratic'. This conclusion has been supported by a number of studies. One study was by Alderfer and Bierman (1970) who experimented with two student groups (groups 1 and 2), and a group of managers (group 3). Groups 1 and 2 were given a questionnaire designed by Kogan and Wallach (1964) to investigate personality differences in risk-taking behaviour. The experiment revealed distinct differences in the decision rules both between student and manager subjects, and among members of the manager group. This study showed evidence of the subjective nature of perceived risk. The finding suggests that, even when presented with the same risk-situation, the final reaction of the decision makers will still be subject to their individual perceptions.

Mao (1970) obtained similar results. He found that managers used significantly different selection criteria in their decisions between risky projects. This suggests that subjective perception of the risk was involved in their decisions. Swalm (1966:135) also agreed that perceived risk is a subjective concept. He maintained that -

> "Attitudes toward risk decisions vary even more widely among various decision makers in a given company than we are inclined to think."

According to Swalm (1966:135):

> "The risk one man would recommend, another would shun as the plague."

Again this suggests the subjectivity of perceived risk. Cooley (1977:76) approached the issue from the investor's point of view. He maintained that -

> "Although risk is related to the uncertainty of future events, and more risk implies more uncertainty, risk is a personal concept reflected by the viewpoint of a particular investor."

Similar results were found by Moore and Thomas (1973), Halter and Dean (1971), Cox and Rich (1967), and Magee (1964). They all acknowledged evidence of subjective behaviour towards risk. There is enough evidence to justify defining perceived or operational risk as a subjective concept. However, this subjectivity depends on a number of factors. The next section will concentrate on describing these factors.

1.4. FACTORS AFFECTING RISK BEHAVIOUR

The preceding section has shown risk perception is based on subjective judgements by individuals. The concept of perceived risk is a highly contextual phenomenon endowed with idiosyncracy. Each person is an individual with their own characteristic traits, and is influenced by the environment or circumstances as he perceives them. Consequently, different people behave differently towards risk. This suggests that two groups of factors affect the decision maker's behaviour towards risk. These groups are:

1) Their Individual Characteristics; and
2) Situational Factors.

These two groups of factors will now be reviewed in detail.

1.4.1. Individual Characteristics

Some psychologists believe that a person's behaviour towards risk depends on whether he is a 'Narrow Categoriser' or 'Broad Categoriser' (Kogan and Wallach, 1964). According to this theory, the Narrow Categorisers are prone to risk. They risk negative instances in an effort to include a maximum of positive instances. By contrast, the Broad Categorisers are risk averse and avoid many positive possibilities in order to minimise the number of negative outcomes.

By implication, the Narrow Categorisers are more concerned that a good opportunity may be missed by not taking risks. On the other hand, the Broad Categorisers often avoid risky opportunities for fear that they might make a mistake, and are not so concerned about missed opportunities. Naturally, the logical question that arises is, why does this happen? Past research has identified three individual characteristics as likely determinants of risk behaviour (Sitkin and Pablo, 1992):

1) risk preferences,
2) risk perceptions, and
3) risk propensity.

Risk preferences have been suggested as one characteristic of individuals that influence their actions (Brockhaus, 1980). Simply stated, decision makers who enjoy the challenge that risks entail will be more likely to undertake risky actions than those individuals who do not.

The second determinant is risk perceptions. Risk perceptions have drawn scholarly attention in part because of their impact on decision makers' behaviour, leading decision makers to deny uncertainty, to overestimate or underestimate risks, and to exhibit unwarranted confidence in their judgements, knowledge and ability to perform under risky conditions (Bazerman, 1986; Rao and Monroe, 1988).

The third individual characteristic posited to influence risk behaviour is risk propensity. Risk propensity has been conceptualised as an individual's risk-taking tendencies - the tendency of a decision maker either to take or to avoid risks. For example, MacCrimmon and Wehrung's (1990) study of executive risk behaviour conceptualises risk propensity in terms of measures of willingness to take risks.

In the arena of individual risk taking, some studies have provided other supporting evidence. For example, Popielarz (1967) seemed to believe that the differences in attitude towards risk exhibited by the subjects could be explained in terms of differences in sexes. MacCrimmon and Wehrung (1990) found that more mature decision makers (in terms of age and seniority) were consistently more risk averse than those who were less mature. Newall (1977) acknowledged the influence of self-confidence, experience, and training on decision makers on their risk-taking behaviour. This has also been given some credence by Slovic (1972:795) who found -

> "A person's previous learning experiences in specific risk-taking settings seem much more

important than his general personality characteristics."

Collectively, these studies suggest that the individual's behaviour towards risk is part of their innerself, and determined by their own personal characteristics. However, it must be pointed out that the individual factors themselves may be triggered by situational factors. It may be an oversimplification to assign a particular behaviour towards risk to an isolated factor alone.

1.4.2. Situational Factors

Although there are many potentially relevant situational factors to influence a decision maker facing risk, we will restrict our attention to a few.

Slovic (1972) accepted the influence of personal characteristics in risk-taking behaviour. However, he found that the decision-maker's propensity to take risks is more a function of the situation and the magnitude of the risk involved than of any personal characteristics. Barach (1969) also gave more weight to situational factors by rating that consumer's attitudes towards risk-taking depend on how important the product may be at the time of purchase. Newall (1977) found supporting evidence, and found other variables significant too. Thus, along with the 'product essentiality', and the 'size of the expenditure involved', which are said to have remarkable influence on risk-taking, 'the degree of newness of the decision to be made', and 'the factors provoking the decision', could also affect attitude towards risk. Collectively, these variables have been described as 'the characteristics of the purchasing problem'.

This issue seems consistent with the thinking of Cox and Rich (1967) who maintain that the risk perceived by the consumer is a function of two general factors: the amount at stake in the purchase decision, and the individual's feeling of subjective certainty that he will 'win' or 'lose' all or some of the amount at stake. Thus, the consumer's attitude towards risk depends on the amount at stake, and the decision maker's assessment of loss or gain from his decision. A study by Binswanger (1981:869) has also given credence to these findings. He found that when the amount liable to loss was increased -

> "Near neutral and risk preferring behaviour virtually disappear."

Swalm (1966) similarly found that some executives who showed risk-seeking behaviour became risk averse, depending on what they thought they might lose. This behaviour towards risk was better demonstrated by Gordon and his colleagues (1972:110). Their findings led the investigators to conclude that -

> "None of the experiment's participants behaved like risk lovers as long as their wealth was large enough to provide some expectations of a livelihood under risk aversion behaviour, and everyone deprived of that expectation became risk lovers."

Attitudes towards risk depend not only on the personal characteristics of the decision maker, but also on what is involved, and the situation in which the decision is made. However, in situations where the decision maker is acting on behalf of his company, a question then arises - are there company-related factors affect the decision maker's perception and behaviour towards risk? Four organisational characteristics have been hypothesised as affecting individual risk behaviour (Sitkin and Pablo, 1992). They are -

1) group composition,
2) cultural risk values,
3) leader risk orientation, and
4) organisational control systems.

According to Janis (1972), of the four organisational influences on risk behaviour, the composition of the group tends to influence individuals to take more risky positions.

Organisational tendencies to prefer certainty versus uncertainty and risk avoidance versus risk seeking may be defined as an organisation's cultural risk values (Douglas and Wildavsky, 1982). These values and the leader's risk orientation represent two additional organisational characteristics that may similarly influence individual risk behaviour in organisations.

Some authors have recognised the important role of leaders in modeling risk-related behaviour and in lending their personal legitimacy to the taking or avoiding of risks (Schein, 1985; Jackofsky et al, 1988).

The organisation's control systems are a fourth organisational characteristic that may influence decision-maker risk behaviour (March and Shapira, 1987). When the outcomes of risky decisions are rewarded or punished (outcome control), or the willingness to take risks is encouraged or discouraged as part of an effective decision-making process (process control), the organisation guides the decision maker's risk behaviour by monitoring, evaluating, and rewarding the outcomes achieved and processes used when risks are involved.

In any case, most companies are expected to have policies and guidelines on decision making involving risk. Since such policies and guidelines not only dictate the proper handling and, perhaps, reduction of company risk, they also 'protect' the decision maker, so he is expected to behave accordingly.

Sitkin and Pablo (1992) found differing results in these two control systems. They found that individuals in a process-controlled organisation will perceive lower risks, as long as a carefully prescribed decision-making process is followed. On the other hand, outcome-oriented control system will lead to perceptions of higher risk, at least for the individual making the decision, because of the possibilities for both large individual rewards and punishments.

Now that we have considered the problems of defining risk, its subjective nature, and the factors which affect our behaviour towards risk, we can go on to review some of the most effective strategies which decision makers use to manage the risk.

1.5. RISK MANAGEMENT IN BUYING

Risk management aims to identify the risks facing a business so that conscious decisions can be taken on how to manage the risks. Risk management is not synonymous with insurance, nor does it embrace the management of all risks to which a business is exposed. In practice, the reality lies somewhere between the two extremes. Risk management must be practical, realistic and cost effective. Risk management need not be complicated, nor does it require the collection of vast amounts of data. It is a matter of common sense, judgement, analysis and a willingness to use a disciplined approach to risk.

The review has concentrated on the issues associated with the definition of risk, its subjective nature, and the factors responsible for this subjectivity. The main aim of this section is to review concepts of risk management strategies for decision makers, particularly in purchasing. The section is divided into two sub-sections. The first sub-section discusses how the individual decision maker manages their perceived risk in buying. The second sub-section discusses the risk management strategies employed by executives in business organisations.

1.5.1. Risk Management Strategies of Individuals

The decision maker's problem is primarily that of choice under conditions that cannot be predicted accurately. As a protective measure, the decision maker tends to develop risk management strategies to handle the hazards associated with decision making. Such risk management strategies include:

* Information gathering, or search,
* Buying from well tried or reputable sources,
* Passing the responsibility on to another person,
* Reducing goals initially set,
* Avoiding the decision altogether, and
* Minimising time and money spent on the decision.

Information search has been widely found one of the most important risk management strategies. Hugstad et al (1987), Woodruff (1972), Cunningham (1967), and Arndt (1967) all described information search as one of the most effective strategies for managing perceived risk.

For example, Cunningham (1967) showed the importance of sources and processing of information by customers, and the use of such information as a risk management mechanism. Sheth and Venkatesan (1968) carried out an experimental study to explore individual consumer's risk-reducing processes over time. They found that both information seeking and pre-purchase deliberations decreased as the purchase were repeated. These findings not only support information search as a risk-reducing strategy, but also show that the higher the perceived risk the more intense the search for information.

Perry and Hamm (1969) provided supporting evidence. They maintain that the consumer's concerns about the social and economic worth of a product he intends to buy leads him to search for more information. Newman and Staelin (1972) also found similar results in their study of household appliance buyers. However, unlike Perry and

Hamm, they found that information search increased directly with the costs of appliances.

Information search has been acknowledged and supported by research as an effective risk-reducing mechanism. Hugstad et al (1987:48) concluded that -

> "Consumers do use different information search behaviours across situations that have different levels of perceived risk."

However, information search is not the only strategy employed to reduce perceived risks. Roselius (1971), for example, included eleven risk-reducing strategies in his study, though most were forms of information search. He found 'brand loyalty' and 'major brand image' evoked consistently favourable responses and were ranked one and two for all types of loss. A recent study by Mitchell and Greatorex (1993) confirmed brand loyalty as the most useful risk-reducing strategy. However, in addition to those strategies mentioned above, a decision to withdraw from an intended decision is also a risk-reducing mechanism, though this is often ignored.

The literature reviewed deals only with how individual consumers handle perceived risk in purchasing decisions that involve relatively small amounts of money. Individual consumers normally use suitable risk-reducing strategy to reduce the perceived risk for any particular purchase. However, the important question is whether these risk-reducing mechanisms are limited to individual consumers, or whether they are also employed by businesses. The following sub-section will therefore consider how business executives representing their organisations handle perceived risks.

1.5.2. Risk Management Strategies of Business Executives

Buying decisions in industrial marketing represent a complex set of activities engaged in by many members of the buying company, and normally result in a commitment to purchase goods and/or services from the vendor. Most studies of risk management strategies in marketing have focussed on the consumer market. However, some studies show that risk handling strategies employed by individuals in the consumer market are, with some modifications, similar to those employed by business organisations to handle their perceived risks in buying. Notable among such studies are those of Henthorne et al (1993), Crow et al (1980), Newall (1977), Cardozo and Cagley (1971), and that of Wind (1970).

Since Newall (1977) covers considerable areas relevant to the present work, it is worthwhile to review it in detail. The determinants of perceived risk used in his study were classified into three main groups:

1) Group one consists of factors which describe the purchase problem. Such factors include:
   (a) the size of the expenditure;
   (b) the type of purchase or buying task;
   (c) the degree of product essentiality; and
   (d) the factors provoking purchase.

2) Group two is made up of factors which describe the industrial buyer. Such factors include:
   (a) his level of general and specific self-confidence;
   (b) his level of decision expertise;
   (c) his purchase history; and
   (d) his education/training background, including his professional affiliation.

3) Group three is comprised of factors which related to or describe the buying or organisational environment.
   (a) the size of the buyer company;
   (b) the financial standing of the buyer company;
   (c) the degree of decision centralisation; and
   (d) the degree of decision routinisation.

After grouping risk factors, Newall proceeded to find out whether a consistent explanation for the levels of risk observed in buying can be given by the factors listed above, taken either in isolation or in combination. His analysis showed interesting results. For instance, although most factors were found to be related in their effects on perceived risk, the primary risk determinants were those in group one that defined the purchase problem, such as the type of purchase and the size of the expenditure involved.

This finding provided supporting evidence for the direct relationship between the level of expenditure involved in a purchase and the level of perceived risk. This was found to be particularly true where the decision to be made concerned a first time purchase. Straight rebuys were naturally found to be characterised by low levels of risk although the risk tended to rise as the cost of purchases increased. It was also found that modified rebuys involving a change in the class of product purchased, or a change in the source of supply, or both, exhibited significantly higher levels of risk.

However, in view of other findings, Newall concluded that the degree to which the factors in group two used in describing the buyer affect perceived risk depends on the nature and the structure of the decision making procedure, as well as the size of the company concerned (factors in group three).

In larger companies it is possible that the highly structured purchase procedure acts as a protective mechanism which reduces or diffuses the risk perceived by members of the buying group. In most small companies, however, such a defence mechanism may not exist so the buyer has to perform many of the buying roles himself. This increases his consciousness of the consequences of the decision in general. The purchase procedure which the buying group in large companies must follow are intended as risk management strategies.

Another issue that Newall's study investigated is the relationship between the time taken to arrive at a formal decision and the level of risk perceived by the buying group. Newall (1977:192) defined the decision duration as:

> "That period of time which elapsed between recognition of the purchase problem and formal sanction of the purchase decision."

The data analysis indicated that the level of perceived risk showed significant associations with the duration of the buying decision. This duration increased as the level of perceived risk increased. Consequently, Newall (1977:195) concluded that it would seem that -

> "There is a direct relationship between the level of risk and decision duration."

Apart from this, the study also considered the question of whether business organisations use source loyalty as risk management mechanism. The analysis showed that buyers involved in high-risk decisions appeared to be no more or less likely to remain loyal irrespective of the degree of buying expertise. However, when company risk variable was used, buyers tended to be significantly less loyal at high levels of company risk. So, Newall concluded that source loyalty did not seem to be an adequate risk-handling mechanism because in decisions involving high levels of company risk, buyers tended to consider many alternative sources of supply.

Information search was therefore found to be a more active form of risk management strategy, once the risk was considered high. However, the nature of information sought differed. Buyers with high expertise tended to seek information from buyer dominated sources, while buyers with less expertise tended to rely on seller-dominated sources of information. This was related to the size and structure of the buyer company so Newall concluded that the nature of the information seeking process itself was a function of the level of the buyer's expertise, the level of risk, and the size and structure of the buyer company.

In addition to the information sought from normal communication channels, Henthorne et al (1993) reported an interesting finding. According to this work, organisational buyers frequently seek informal, personal sources of information in seeking information about a new-task situation.

An experimental study by Cardozo and Cagley (1971) also provided supporting evidence, not only for source loyalty as a risk management strategy but also for information search as a risk management mechanism. This findings generally showed that procurement managers preferred well known firms and firms which provided much information about themselves as bidders over unfamiliar firms and those which provided less information. This preference was found to be significantly greater in high-risk than in low-risk purchase situations. Procurement managers sought more information in high-risk than in low-risk situations. Crow et al (1980) also showed that industrial buyers not only search for information but also make use of information sought to handle perceived risks in evaluating potential sources of supply.

Obviously, there are differences when risk is considered in terms of the individual decision maker and the organisation. However, the research shows that the risk management strategies employed by individual decision maker are comparable to those employed by business executives making decisions on behalf of their organisations. The differences are largely a matter of degree. This point is also supported by Libby and Fishburn (1977). They maintain that although many business decisions were products of group discussions, the basic risk factors considered by groups tended to be similar to those considered by individuals. However, they acknowledged that three factors may reduce the effect of individual characteristics on business risk-taking behaviour. These factors are:

1) Personnel selection and promoting processes may produce a relatively homogeneous group of decision makers within a company;
2) Common training, experience, and feedback received by decision makers also tend to minimise deviations from company risk policies;
3) Since many business decisions are made by committees, some of the remaining personal differences tend to be deemphasised when individual judgements are combined to form group decisions.

Slovic (1972) maintained that individual risk-taking levels tend to increase as a result of group discussions, and group decisions tend to be riskier than the average of the individual member's decisions prior to group discussions. This happens because of the shared nature of the decision. There is a tendency for each individual to feel absolved from the responsibility for the consequences of the decisions.

The composition of a firm's top-management team (TMT) has recently received increased attention. Some authors (Fredrickson and Iaquinto, 1989; Hambrick and Mason, 1984) indicated that the mean level of a homogeneous TMT's risk perceptions is likely to be more extreme than the mean for a heterogeneous team. That is, when an individual who is a member of a homogeneous team makes individual decisions, his risk perceptions will be more extreme than the perceptions of a member of a heterogeneous group.

Regardless of whether the risk is personal or impersonal, the basic mechanisms for managing perceived risks are the same. Any distinction seems largely a matter of degree.

Based on theoretical discussions and empirical findings, we expected that sellers, represented by construction companies, also perceive and manage risk in their decision making about contract. Hypothesis H1 is formulated:

H1: Construction companies perceive risks in their contracting process, however the level of perceived risk is determined by situational factors.

For the sake of clarity, hypothesis H1 can be expanded:

H1a: The larger the project/contract value, the greater the number of contractors that perceive risk.

H1b: The larger the size of the contractor, measured by its annual turnover, the less likely it is to perceive risk.

H1c: Contractors' decision makers in upper management will perceive risks to be lower than those in lower managerial positions.

H1d: The risk perception by contractors is inversely related to the client's knowledge of his needs.

1.6. CONCLUSION

Most of these research studies deal with how individual or organisational decision makers perceive and handle their risk in buying. One interesting finding from the review is the lack of research on how the sellers perceive and manage their risks. Little attention has been focussed on the behaviour of sellers.

The assumption is that only buyers perceive risk and develop strategies to manage it.

This study does not share this one-side view. Contractors in the construction industry may also be in danger from risk in their selling activities and these risks can be managed by applying appropriate strategies.

Nevertheless, production of construction products needs materials inputs as contractors are intermediaries in the construction industry, not only selling their products but also purchasing building materials. Although this study focuses on the perception and management of risk by contractors in their contract selling processes, a brief description of contractors' purchasing processes and supply chain linkages is discussed in Chapter Four.

CHAPTER TWO: RISK MANAGEMENT SYSTEM IN CONSTRUCTION

2.1. INTRODUCTION

Chapter One reviewed a number of studies that concentrated on issues associated with defining risk, its subjective nature, and risk management strategies used by decision makers in purchasing. This chapter discusses general concepts of risk management in the construction industry.

Risk and uncertainty are inherent in all construction work. The construction industry is subject to greater risk and uncertainty than most other industries. Lifson and Shaifer (1982) noted that construction managers operate in an unfriendly world. Competition forces unprofitable bids; suppliers may raise prices or fail to deliver as promised; employees may want more money, make mistakes, arrive late or strike; and the weather may turn bad when a project is near the completion date. The construction industry has had a poor reputation for coping with risk, with many major projects failing to meet deadlines and cost targets. Both clients and contractors have suffered as a result. A study (NEDO, 1983) on industrial building in the UK confirmed that many projects overrun both cost and time targets. A major building under construction in London, is reputedly suffering a six month delay that is costing the owners 40% more in capital cost (Orman, 1991). When serious overruns occur their effect on the overall project can be very damaging. In extreme cases, time and cost overruns can turn a potentially profitable investment into a loss-making venture.

Dealing with the risks that such events might occur, and with their consequences when they occur, is the art of risk management (Mehr and Hedges, 1974). Al-Bahar and Crandall (1990:534) defined risk management as:

"A formal orderly process for systematically identifying, analysing, and responding to risk events throughout the life of a project to obtain the optimum or acceptable degree of risk elimination or control."

The concept of risk management is not new. Healy (1981) endeavoured to systemise the process of risk management and establish a generally acceptable terminology suitable for construction risk management. Despite some attention to risk management techniques since the late 1980s, there is little evidence of their formal adoption by project participants (Langford et al, 1995).

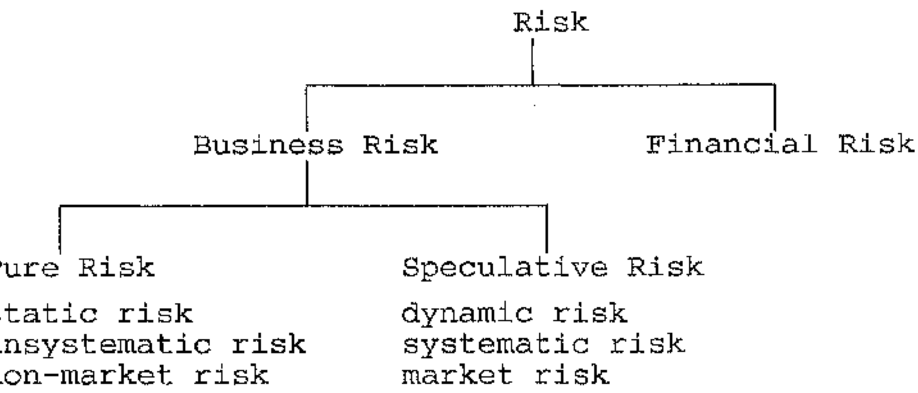
This chapter examines the underlying theory of risk management in the construction industry to understand the principles and processes of risk management. Risk analysis is a key aspect of risk management, and various techniques for risk analysis are discussed below.

2.2. TYPES OF RISK IN CONSTRUCTION

Construction, like many other industries in a free-enterprise system, has sizable risk built into its profit structure. All parties involved in the construction industry are exposed to various risks, such as business risk, financial risk, and even physical risk. A common method used for classifying risks is shown in Figure 2.1. The first distinction is between business risk and financial risk.

Business risk is associated with asset risk which includes capital expenditure, gross possible income, credit losses, operating expenses, and property value (Pyhrr and Cooper, 1982). It is described as the probability that the expected returns from the investment will not be received. Brigham (1989) defined it as the uncertainty inherent in projections of future operating income, or earning before interest and taxes. Business risk can be further classified into pure risk and speculative risk (Flanagan and Norman, 1993).

Figure 2.1. Classification of Risk



Pure risk is sometimes called static risk, non-market risk, or unsystematic risk. Pure risk results in a loss. It is related to physical cause and effect, occurs at random, and is beyond the control of the decision maker. Examples include damage to property caused by fire, earthquake, storm, flood, or war, or losses caused by personal injury, theft, or 'malicious mischief'. Normally, these risks can be insured against because they are predictable over the long run. Speculative risk is sometimes called dynamic risk, systematic risk, or market risk. It involves the possibility of both gain and loss for a business. These are known as upside and downside risks (Raftery, 1994; Al-Bahar and Crandall, 1990). This kind of risk is related to changes in general business conditions and the physical condition of property. Healy (1981) points out that dynamic risk is related to market demand and supply conditions, the age of the property, changes in the economic base, environment, politics, technologies, and so on. Changes in these could cause changes in the purchase price, the net operating income, the value of the property, and related tax benefits; all these may affect returns and impose risks.

Financial risk refers to the extra risks a business creates by debt financing (Pyhrr and Cooper, 1982). In other words, financial risk depends on the amount of financing provided by creditors (Pinches, 1992). Financial risk increases whenever the amount of debt or related charges increases. In many cases, companies such as property development companies require a large amount of initial outlay. The use of debt, leases, or preferred stock exposes the company to more risk if the expected or required rate of return on total capital will not be realised. In worse situations, this may threaten the existence of the company.

2.3. RISK MANAGEMENT SYSTEM

Both industry and academia have become increasingly interested in risk management since Hertz (1964) introduced the concept. Many sophisticated models and management techniques for risk management have been developed. These include such techniques as sensitivity analysis, utility theory, and simulation theory. It is contended that the effective management of risks will reduce the requirement for contingencies making bids more competitive, projects more profitable and customers more satisfied (Newland, 1995). An effective risk management method can help in understanding not only what kinds of risks are faced, but also how to manage these risks at the stages of contracting and construction (Zhi, 1995). However, Al-Bahar and Crandall (1990), and Ward et al (1991) found that the quality of risk management is improved only if risks are identified and evaluated in a systematic way. It is only in the past decade that these techniques have been systemised and applied within the industry. One approach suggested by Healy (1981) suitable for construction risk management is a risk management system comprised the elements of risk identification, risk analysis, and risk response. However, risk management does not remove all risk from the project rather it aims to ensure that risks are managed most efficiently (Perry and Hayes, 1986).

Stage 1: Risk Identification

Risk identification provides an understanding of the nature of risk. It will identify and characterise the source and types of risk, and provide a preliminary assessment of their consequences. It is worth stating that an identified risk is not a risk, it is a management problem (Flanagan and Norman, 1993).

Stage 2: Risk Analysis

Risk analysis gives a quantitative description of the risks. Primarily, it evaluates the consequences associated with the type of risk or combination of risks, by using various analysis techniques such as sensitivity analysis, probability analysis, and decision tree analysis.

Stage 3: Risk Response

A response is any action or activity that is implemented to deal with a specific risk or combination of risks (Isaac, 1995). Risk response considers how the risk should be managed: either by avoiding it, or by reducing it, or by transferring it to another party, or by retaining it. There is a common misconception that people always wish to avoid risk (Murdoch and Hughes, 1992). This is not necessarily so. Risk response will suggest the correct action to be taken in the light of the results from the preceding analysis.

Such a rationale of risk management system is a relatively natural activity at the beginning of the project. However, unless careful management control plans are developed and implemented after the project start, the proactive management objective will be overtaken by the reactive environmental influences which permeate construction projects (Dreger, 1990).

2.3.1. Risk Identification

Risk identification is the first process of the risk management system. It is the stage during which all potential risks affecting the estimates of future outcomes should be identified by considering their sources and effects. Then risk analysis and response management may only be performed on identified potential risks. It is important to distinguish the effects of risk from their sources in a sequence (Flanagan and Norman, 1993; Perry and Hayes, 1986):

SOURCE ----> EVENT ----> EFFECT

For example, the sources of risk can be:

* exceptionally poor weather
* unforeseen adverse ground conditions
* inflation rising above its estimate
* late delivery of crucial materials, for instance after a fire at a supplier's works
* incorrect design details, such as the wrong size beams being shown on the architect's drawings
* no co-ordination, for instance between the mechanical services contractor's drawings and the suspended ceiling specialist's drawings

The most serious effects of risks are:

* failure to keep within the cost estimate
* failure to achieve the required completion date

* failure to achieve the required quality
* failure of the project to meet the required operation needs
* damage to the property as a result of fire or flood during construction
* injury to a worker due to an inadequate system of work practices

The identification of risk must be linked to a clear statement of the priorities for a project, so that e.g. if the timing of the project is critical, the severity of time-related risks is automatically increased. Because it is not obvious to think systematically of the source of risks, the event and the effects of risk, risk identification has emphasised risk sources. Hayes et al (1986:9) suggests a key question in risk identification is:

> "What are the discrete features of the project (risk sources) which might cause such failure?"

2.3.2. Risk Analysis

The second step in the process is to analyse each of the risks in terms of their likely frequency of their occurrence, their likely severity when they do occur and the range of possible values in terms of minima, maxima and medians for each of these aspects. Many risks and uncertainties have quantifiable effects on cost, time or revenue. Risk analysis quantifies the effects on a project of the major risks that have been identified. Risk analysis is an integral part of the risk management system. The essence of risk analysis is to provide a means to analyse possible events and their probability of happening. Analysis helps the decision maker decide whether or not to approve some option or project, or whether they should adopt some particular strategy with regard to the future risks.

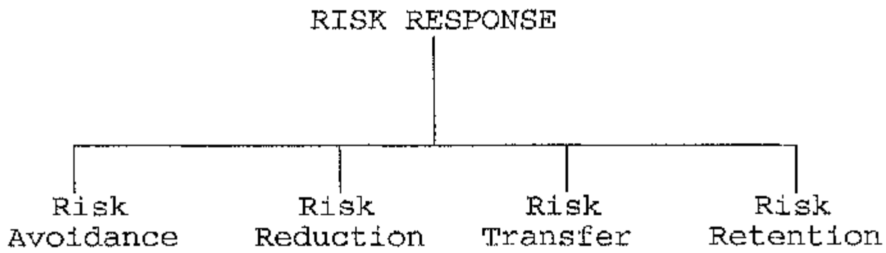
The most important step in the risk analysis process is the collection of data relevant to the risk exposure to be evaluated (Al-Bahar and Crandall, 1990). The common principle behind any risk analysis technique is to allow a range of values for the various uncertainties and gauge their effects. For example, completion time of the project, construction cost, and estimated profit are not given single values, but considered over a range of values within which the decision maker believes they are likely to lie. Analytical techniques have been developed specifically for this task. The various techniques of risk analysis are thoroughly described by Hertz and Thomas (1983) and others (Marshall, 1991; Hayes et al, 1986; Lifson and Shaifer, 1982). The various methods now available for risk analysis are described later in this chapter. However, Lave (1987:294) emphasised that -

> "Since the risk estimates have major uncertainties, they may be useless to the risk manager."

2.3.3. Risk Response

After the decision-maker has obtained information about the risks and their effects through risk identification and risk analysis, the decision-making stage is reached. A decision must be made whether or not an option should be taken, what methods should be taken to deal with those risks to soften their possible impacts, and who is best placed to manage a risk. These decisions and subsequent actions are the risk response. There are four ways to respond to risk, to avoid it, reduce it, transfer it, or retain it, as shown in Figure 2.2. The response to risk can take any of four basic forms, or they may be used in combination. The best approach will depend upon circumstances, and different businesses or people will also have their preferred responses.

Figure 2.2. Risk Response



2.4. METHODS USED FOR RISK IDENTIFICATION

While the concepts of risk identification have been discussed in the preceding section, this section will concentrate on how risk identification is carried out using various methods. Risk identification is the process used to find risks and to enable the manager to understand the potential risk sources in the early stages. This allows a concentration on strategies for the control and allocation of risk. The effective methods for risk identification are proposed as:

* Risk list method
* Arrow method

2.4.1. Risk-list Method

The risk-list method provides a list of risks for a project, with each risk listed under a number of possible headings, all of which must be considered in order to obtain a complete picture. Recent research shows that the checklist, the simplest of all the techniques, is the most favoured, and is in heavy use (Simister, 1994).

Perry and Hayes (1985a) provided an example of the risk-list method. They listed the risks as including:

* Physical
  - Loss or damage by fire, earthquake, flood, accident, landslip
* Environmental
  - Ecological damage, pollution, waste treatment
  - Public enquiry
* Design
  - New technology, innovative applications, reliability, safety
  - Detail, precision and appropriateness of specifications
  - Design risks arising from surveys, investigations
  - Interaction of design with method of construction
  - Likelihood of change
* Logistics
  - Loss or damage in the transportation of materials and equipment
  - Availability of expertise, designers, contractors, suppliers, plant, materials
  - Access and communications
* Financial
  - Availability of funds, adequacy of insurance
  - Adequate provision of cash flow
  - Exchange rate fluctuations, inflation
  - Taxation
* Legal
  - Liability for acts of others, direct liabilities
  - Local law
* Political
  - Changes in political policies and law
* Construction
  - Feasibility of construction methods, safety
  - Industrial relations

- Extent of change
- Climate
- Quality and availability of management and supervision

* Operational
  - Fluctuations in market demand for product or service
  - Maintenance needs
  - Fitness for purpose
  - Safety of operation

Other researchers have looked at additional risks. Construction risks identified by Baldwin et al (1971):

* weather
* sub-contractor
* finances
* materials shortage
* design changes
* equipment failure
* calculation mistakes
* contracts
* building codes
* labour supply
* manufactured item
* foundation condition
* shop drawings
* permits
* jurisdictional disputes
* samples approvals
* inspections

Construction risks identified by Byrne (1972):

* labour cost
* flood and pestilence
* unusual weather
* construction equipment cost
* unknown physical features
* recording and preserving archaeological finds
* hazards of government regulations
* slow action of employer's finance

However, recognising that construction projects are unique and different in concept and performance, specific risks can only be identified correctly by considering the actual environment of each individual project. Although the various risk lists are general sets of risks drawn from practical projects, there is no single one which is commonly used. A risk-list is used to provide a framework to help find the actual risks and ensure that none are overlooked. A risk-list is a comprehensive survey of the risks in general but must be associated with a particular project. Despite the fact that substantial effort has been devoted to establishing a systematic identification process, success is still heavily dependent upon the experience combined with intuition of the contractor identifying the risk.

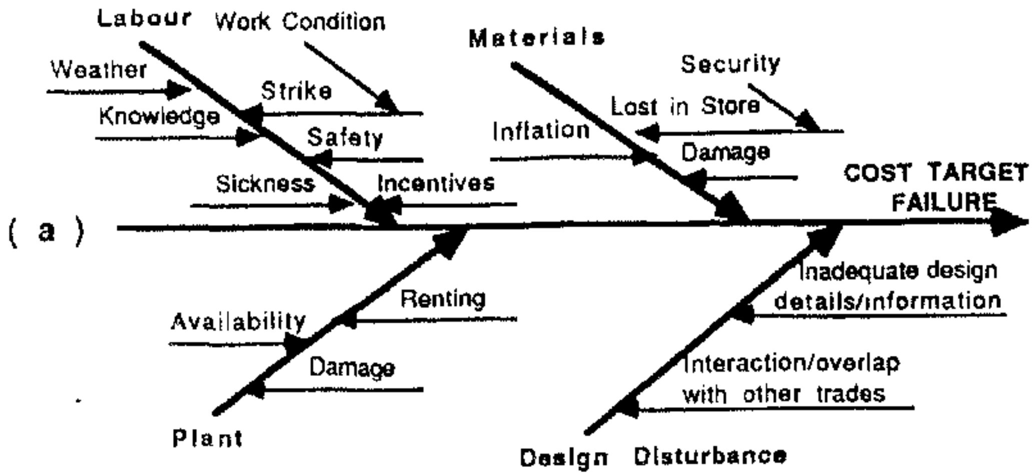
2.4.2. Arrow Method

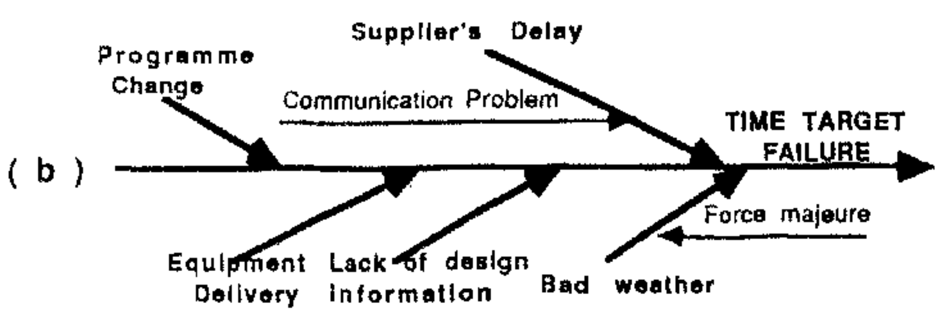
The arrow method (Shen, 1990) relates the risk effect and risk source explicitly. By this method, the general risk effects are marked on a horizontal axis. In Figure 2.3. two possible risk effects are shown, that is, cost target failure and time target failure. The sources of the effects are ranked as main sources, sub-sources, sub-sub-sources, and so on, depending on how detailed the available information is. The main sources are connected with the risk effect axis by arrows, sub-sources with main sources by further arrows, etc.

2.5. METHODS USED FOR RISK ANALYSIS

Hertz and Thomas (1983) has mentioned that many uncertainties are quantifiable in terms of their size and their effect on project cost or completion time. The quantification process of these uncertainties is commonly called risk analysis. In the past, many risk analysis techniques such as sensitivity analysis, probability contours, probability distributions, decision trees, Bayesian analysis, utility theory application, and simulation have been developed. Statistical methods and computation are the main tools used to aid risk analysis.

Figure 2.3. Arrow Method for Risk Identification





The choice of technique, however depends on the available experience and expertise. The aims of the analysis, and the time available to carry it out, will also influence the choice. Hayes et al (1986:14) has indicated that -

> "They are not substitutes for professional judgement. This is certainly true of the techniques used for risk analysis."

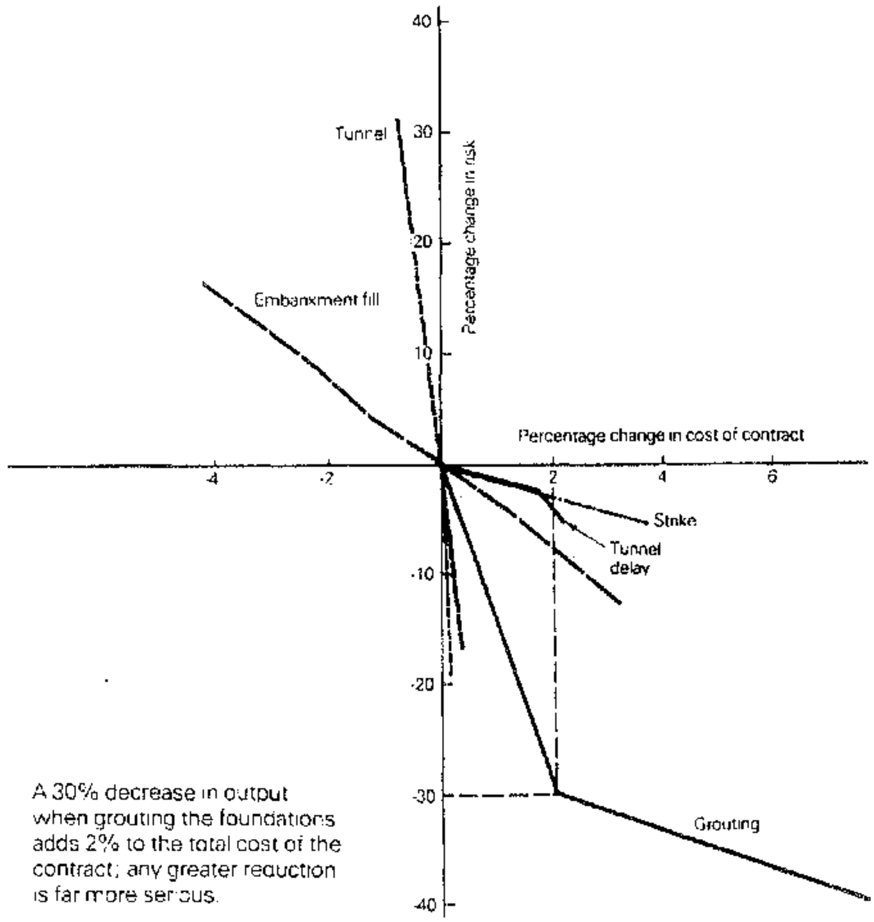
Some common methods and techniques currently available are described below. Further information on risk analysis techniques are found in Raftery (1994), Thompson and Perry (1992), Marshall (1991), Al-Bahar (1988), Perry and Hayes (1985b), Lifson and Shaifer (1982), and Newendorp (1975).

2.5.1. Sensitivity Analysis

Sensitivity analysis is the simplest form of risk analysis. It determines the effect of changing individual risk variables on the specified goal. It varies one factor and holds all the others constant to find how much this one factor affects the objective, for example, project cost on completion time. The importance of sensitivity analysis lies in finding those risk variables which have the largest impact on the objective. There is no need to have a probability distribution for each risk. The analysis involves just a repetition of the original calculation of the project outcome by using different values of the risks. Each risk is considered individually and independently with no attempt made to quantify probability of occurrence.

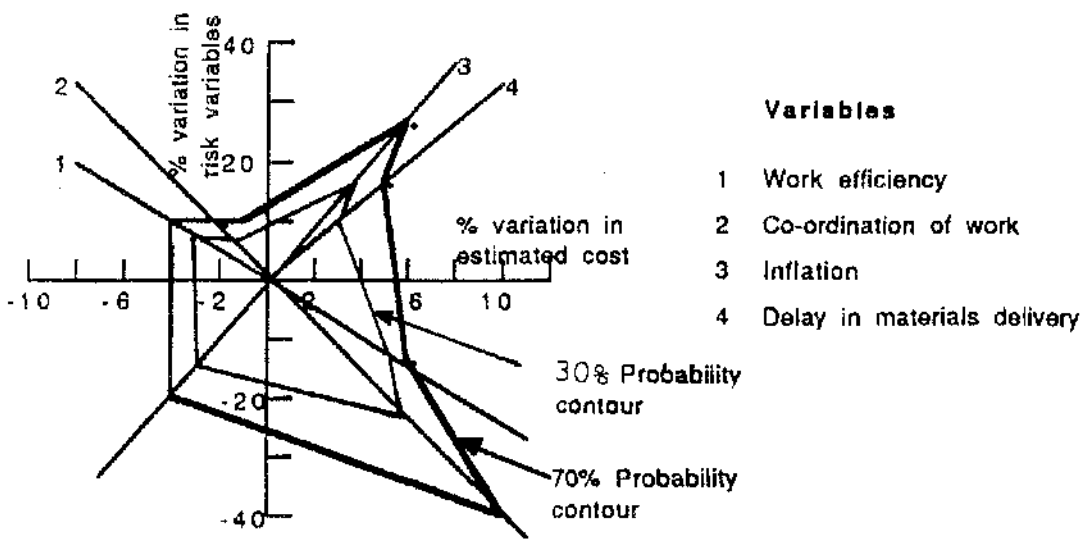
Sensitivity analysis is often accomplished using a graphical diagram. This is used to present the results of a sensitivity analysis. When several risks are being assessed in this way, a graph of the results called 'spider diagram' is used. Hayes et al (1986) have given an example in Figure 2.4., calculated for a reservoir contract. In this particular case the diagram shows the effects of changes in the risks against the cost of the contract, but any cost or time indicator can be used. It is immediately obvious from this diagram that a decrease in output when grouting can have a surprisingly significant effect on the overall contract cost.

Figure 2.4. Spider Diagram



Nevertheless, sensitivity analysis has two weak points. The first is that risks are treated individually without considering dependences and correlation among risks - only one risk is varied at a time. The second is that it gives no indication of the anticipated probability of occurrence of any event. It is possible to overcome these defects, at least to some extent, by using contour analysis techniques. Perry and Hayes (1985a) combines the concept of probability contours with a spider diagram. Figure 2.5. shows such a diagram, with a 70% probability contour and 30% probability contour added respectively. Some criticism has been made of the use of the probability contours because the likely range of variation of each parameter is a subjective estimate. Also, the method cannot present a probability distribution of any risk.

Figure 2.5. Probability Contours



In theory, a sensitivity analysis will be performed for a large number of risks and uncertainties in order to identify those which have a significant impact on cost, time, or economic return and to which the project will be most sensitive. However, the number of risks assessed can be reduced with experience since those having a high impact tend to become easily recognisable.

2.5.2. Probability Analysis

Sensitivity analysis, though simple to apply, considers risks in isolation. In reality it is likely that some combination of the risks will occur.

Probability analysis is a more sophisticated form of risk analysis. It is used to overcome these limitations of sensitivity analysis. By specifying a probability distribution for each risk, the outcomes of objective variables can be produced through considering changes in all the risks in combination. In other words, each outcome is a combination of individual risk probability distributions. Therefore, all the possible outcomes form an outcome distribution.

However, defining the probability distribution for each risk is very difficult. Every project has many unique features and political, commercial and fiscal environments change quickly. Nevertheless, it is possible to make tentative estimates of probability distributions and ranges. Defining the probability distribution is not only a statistical question, but also a creative process requiring management experience. Like sensitivity analysis, it is a subjective judgement. The important point is to make sure that the form of distribution chosen can represent the reality as precisely as possible.

Probability analysis has had notable successes in terms of its predictive ability and consequent assistance to managers in decision making. Nevertheless, there are still some weaknesses in its application. For example, the difficulties of considering correlations between risks have long been recognised, but adequate techniques to manage these difficulties appear to be lacking. There are some other difficulties including the number of variables, the range of variation, and the choice of distribution form for each risk. It is particularly true for cases with few observation or data as is common in the construction industry. The Monte Carlo simulation method partially overcomes the problem and will be explained later.

2.5.3. Decision Tree Analysis

Decision-tree analysis is a multi-stage analysis. It is a graphical means of bringing together the information needed for decisions. It shows the present possible courses of action and all possible outcomes. Each event must be given a probability value indicating its likelihood of occurrence. One of the principal advantages of this approach to risk and decision making is that it forces the manager to identify/recognise the probability of an event occurring. Future outcomes are considered, the likelihood of failure is quantified, and some value is placed on each decision.

This type of risk analysis is usually applied to the costs of a project. Further details of the application of this technique can be found in standard texts (Brockington, 1993; Philippatos, 1973). Its major application appears to have been in the oil and coal industries (Newendorp, 1975). In the construction industry, it appears suitable for wider application by clients in their investment decisions and by contractors in selecting alternative construction methods (Hayes et al, 1986).

2.5.4. Bayesian Analysis

Bayesian analysis is a risk adjustment approach. The term, risk adjustment, means the original risk assessment (probability distribution) needs to be adjusted or amended when new information becomes available, in order to improve the accuracy of probability estimates for each risk. The original probability distribution is called the prior probability distribution, and the probability distribution which has been amended in the light of new information coming to hand is called the posterior probability distribution.

Commonly, risks are described by some probability distributions which are normally specified before the real risk actually occurs, and derived from the analysis of existing information as well as subjective intuition. However, as time goes on and the situation changes, more new information will emerge about the risks concerned. This new information will usually change the original probability distribution and there is a deviation of the original probability distribution from the real probability distribution. Consequently, it will affect the accuracy of the information to support decision-making. Bayes' Theorem can be used to amend the original probability distribution in order to reduce the deviation from reality and increase the reliability for subsequent decision-making.

Therefore the posterior probability distribution is more reliable than the prior probability distribution because it takes new information into account. This emphasised that risk management should be based upon both experience or subjective assessment and new information. New information can play an important part in handling risks and making decisions. Bayes' Theorem provides the theoretical foundation for using it.

2.5.5. Utility Theory

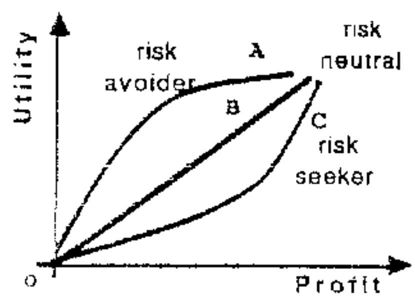
None of the above techniques take account of the attitude of the decision maker to risk, or to the magnitude of risk. It may be unreasonable, for example, to assume that a possible loss of 90% of available capital would be considered with the same equanimity as a loss of 10%. Utility theory attempts to quantify the decision-maker's attitudes towards risks, and thereby provide a comparative basis of individuals' risk attitudes.

The general approach to dealing with risk or uncertainty is to specify risk variables by probability distributions. However, an individual's attitude to risk is also an important risk variable. The decision maker has to choose a policy from among multiple possibilities, any one of which will result in a payoff or outcome which cannot be known in advance. The 'risk environment' is perceived in differing ways by different people. Different decision-makers have different attitudes to the risk environment, and these attitudes are reflected in the implicit value they give to each policy, each policy being understood as the strategy chosen from among multiple possibilities. Some people are risk takers by nature, willing to take additional risks on the expectation of a higher return. Others are risk neutral, indifferent to return except if it can be calculated to be worth the risk. Yet others are risk averse, willing to sacrifice the possibility of a higher return even for a relatively small risk.

Philippatos (1973) interpreted utility as want-satisfying power, a state of mind - known to the decision maker by introspection. Utility theory endeavours to assess the decision profile of the individual or corporate decision maker (Perry and Hayes, 1985a). Utility is a measure of the individual's evaluation, or implicit value, or preference, for each policy in a risk environment. It is a tool in the process of decision-making. It enables managers to quantify what appears to be a totally subjective choice dependent on an aspect of human nature. In essence it attempts to formalise management's attitude to risk.

To be of use in decision making, utility values must be assigned to all possible outcomes, because the decision maker's choice will change according to the risk involved. This relationship between expected return and choice is commonly expressed by the utility function. It is illustrated in the form of a utility curve as shown in Figure 2.6. with the utility scale on the vertical axis and the expected outcome on the horizontal axis.

Figure 2.6. Three Types of Utility Curve



In the real world outcomes can be both monetary and non-monetary in nature. For example, in making a decision regarding a job, one has to weigh such factors as geographical area, potential advancement, annual salary, number of days holiday, etc. People are able to assign utility values to such non-monetary outcomes. Instead of using expected monetary value as the criteria of choice, the money is replaced by utility and the expected utility value (EUV) will then apply. As Hertz and Thomas (1983:178) state that -

> "The role of utility is the same whether the outcomes are monetary or non-monetary; single variable or multi-variable; quantifiable or non-quantifiable."

Individual decision makers cannot be expected to act rationally and consistently in every situation with respect to their revealed utility-money functions (Marshall, 1991). However, in most business decisions, the monetary consequence is of major importance. In summary, a utility function has the following properties:

* each possible outcome is defined by a single number
* the outcomes are ranked in order of preference
* the objective is to maximise expected utility

Although Erikson (1979) deduced that construction contractors are risk averse and Porter (1981) concluded that clients are risk neutral, Perry and Hayes (1985a) pointed out that within the construction industry utility theory tends to be regarded as a theoretical technique, not easily applied. However, according to Hayes et al (1986) it does attempt to address a central problem of decision making under uncertainty - the attitude of management itself towards risk.

2.5.6. Simulation

Bayes' Theorem provides one way to ammend risk probability distributions in order to express risk properly. However, the most important aspect of risk analysis is to consider changes in all risks in combination. The essential ingredient of probability analysis is the assessment of how risks can occur in combination with the consideration of their distribution type. Simply adding statistical distribution together is meaningless. Rubinstein (1981) suggested the best way for dealing with many risks jointly is simulation, particularly simulation using random numbers - the so-called Monte Carlo method. The Monte Carlo simulation method is the most popular of several simulation methods (Hutchinson, 1993). The main principles of this simulation can be described as:

* The range of values for all risks concerned are assessed together with their individual probability distributions;

* A value for each risk within its specified range is randomly chosen with consideration of distribution type;
* Each outcome of the decision variable is calculated using the logical combination of values selected from each one of risk;
* The calculation is repeated a number of times to obtain an outcome distribution. The number of cycles depends on the degree of confidence required, but usually lies between 100 and 1000.

The basic application of simulation in construction risk management is to produce probability curves or frequency histograms for both cost and schedule, while considering all risk distributions together. Computer programmes are the main tool used for this simulation analysis. Various simulation models have been developed to deal with risks in different ways, such as CPS - the Construction Project Simulator (Bennett and Ormerod, 1984), PERM - the Project Estimate and Risk Monitor (Property Services Agency, 1985), SCERT - the Synergistic Contingency Evaluation and Review Technique (Chapman, 1979; Chapman and Cooper, 1983), and CASPAR - the Computer Aided Simulation for Project Appraisal and Review (Thompson and Willmer, 1985).

The CASPAR programme is a project management tool designed to model the interaction of time, resources, cost and revenue throughout the entire life of a project. It has been used in the appraisal of many major projects including tidal power schemes in the UK and a variety of high-risk projects such as dams and pipelines overseas (Thompson and Perry, 1992). This technique has been useful in demonstrating robustness to financial and construction risks associated with the engineering, operation, and management of the project, and identifying critical uncertainties for further work. Since the main theme of this chapter is to introduce some concepts of risk management system, the details of simulation application with computer programmes will not be further discussed.

One important point should be noted here: there is no such thing as a software-only solution to the problem of risk management. Raftery (1994) pointed out that risk analysis software is neither necessary nor sufficient for risk management. Rigorous, comprehensive and competent risk analysis is primarily dependent on the attitude of mind of the appropriate decision makers and their advisers. Risk analysis is a supplement to, not a substitute for, professional judgement.

2.5.7. Which Technique is Best

If it can be agreed that better decisions come from more complete information, then accounting for uncertainty and risk will enhance decision making. Yet there is no 'best' technique for handling uncertainty and risk in evaluating every project. What is best will depend on circumstances of the organisation. Marshall (1991) suggests that the decision maker and analyst should consider the following factors of information before selecting a technique for a given problem.

First, the level of resources must be assessed. For example, how much time is available to evaluate the project? How much money is available for staff and computer support? Does the staff have the technical capability to apply the techniques? By asking these questions, the set of feasible techniques (where feasibility depends on resource availability) can be defined.

Second, the particular audience that will use the analysis must be identified, and their reactions to the techniques should be considered. For example, has executive judgment and intuition been successful in the past? Will the management team understand the information generated from applying the techniques? If the chief executive has been choosing profitable projects on the basis of personal judgments and deterministic, single-value estimates of project worth, then the analyst who presents cumulative distribution functions using the simulation technique will probably have little influence.

Third, the approximate size of the project relative to the institution's total budget or turnover should be taken into account. for example, if the project to be analysed were small relative to the total budget, and would affect only slightly if it yielded a poor return, then a sophisticated approach to risk analysis such as the mathematical/analytical technique would not be needed. On the other hand, if the project were relatively large, and a poor return could bankrupt the institution, then a sophisticated technique might be needed.

Fourth, risk attitude should be considered in choosing a technique. For example, if the decision maker were risk neutral, then the procedure to account for risk attitude would be unnecessary. If the decision maker were very risk averse or a risk taker, on the other hand, it becomes appropriate to use techniques that can adjust for risk attitude.

Although the risk analysis concept is relevant in the construction industry and the level of awareness of these analysis techniques is high (Simister, 1994), the difficulty of treatment of correlated variables makes it difficult for risk analysis to be effective in the contract decision making. This suggests the following hypothesis:

H2: Rigorous risk analysis techniques are not widely applied in the contracting process of the construction industry, instead the more traditional techniques are still favoured for risk analysis.

Hypothesis H2 is further elaborated as follows:

H2a: Construction contractors prefer traditional qualitative risk analysis techniques, such as checklists, brainstorming and expert interviews, to quantitative analysis techniques in performing risk analysis.

H2b: Construction companies do not use risk departments.

H2c: The estimating department carries out risk analysis in a traditional way.

H2d: Estimators tend to over-compensate their cost estimates in determining the bid.

2.6. METHODS USED FOR RISK RESPONSE

Any appropriate risk response can only be made following a thorough identification and analysis of risks. The general guiding principle of risk response is that the parties to the project should seek a collaborative and mutually beneficial distribution of risk. As we mentioned in Section 2.3., risk response can be considered in terms of the four methods:

* Avoidance
* Reduction
* Transfer
* Retention

These approaches can all effectively be used in construction activities, depending on circumstances.

2.6.1. Risk Avoidance

Risk avoidance is synonymous with refusal to accept risks (Flanagan and Norman, 1993). The refusal to contract is a simple example of risk avoidance. It was once thought that by performing in accordance with one's contractual scope (timeliness, quality, reasonable standard of care, etc.), any risks would be avoided

(Manzi, 1985). However, as soon as one party agrees to perform an element of work, a risk is born.

Normally, risk avoidance is associated with pre-contract stage. The greatest degree of uncertainty about the future is encountered early in the life of a new project. Decisions taken during the earliest stages of a project can have a very large impact on its final cost, and its duration. Usually at the project appraisal stage the client can consider avoid risk by reappraising the project or even the replacement of the project by an alternative project. For example, if the financial viability of the project is entirely dependent on the existence of a particular government subsidy, and there are legislative moves afoot to end such subsidies, it may be thought prudent to redefine the project such that it is not dependent on such ephemeral support. At the bidding stage the contractor can avoid risk by redesign, if allowed by the contract documents.

Avoidance is a useful, fairly common strategy to managing risks (Al-Bahar and Crandall, 1990). By avoiding a risk exposure, the contractor knows that he will not experience the potential losses that the risk exposure may generate.

2.6.2. Risk Reduction

The idea of reducing risk is to eliminate the risk sources wherever possible. It is directed towards decreasing the contractor's exposure to potential risk by two ways:

* Reducing the probability of a risk;
* Reducing the financial severity of risk if it does occur.

This is normally achieved through the action of more detailed design, or even redesign, further site investigation, a clear understanding of the packaging of the work content, the use of alternative contract strategies with sub-contractors, the use of different methods of construction, or the use of different resources including manpower, materials and equipment. Perry (1985) states that it is perhaps more likely that risk identification and analysis will indicate the need for redesign, different packaging of the work content or different methods of construction in order to reduce or avoid risk.

2.6.3. Risk Transfer

Risks are inevitable and cannot be eliminated. They can, however, be transferred. Risks can be redistributed and transferred to other party by taking out insurance, the careful drafting of contracts, and so on. For example, lump sum contracts usually carry a high risk for the contractor but little for the client. The distribution of risk can be equalised by splitting work into lump sum and cost reimbursable tasks between contractor and client. The four most common routes for the transfer of risk in construction activity are:

* client to contractor or designer
* contractor to sub-contractors
* client, contractor, sub-contractor or designer to insurer
* contractor and subcontractors to sureties or guarantors

A contractor can transfer risks to a sub-contractor or to an insurer. Methods of transferring a risk to another party are adequate clauses in the sub-contract or an insurance policy. However, it is argued that some risks cannot be insured and these must remain the responsibility of the party to which they are allocated.

The essential characteristic of the transfer response of risk is that the consequences of the risks, if they occur, are shared among the parties concerned. Following the work by Perry (1986), Perry and Hayes (1985a), Abrahamson (1984), Barnes (1983), Porter (1981), and Ashley (1977), the fundamental principles which govern the transfer of risk can be stated as follows:

* which party can best control the events which may lead to the risk occurring;
* which party can best manage the risk if it occurs;
* whether or not it is preferable for the client to retain an involvement in the management of the risk;
* which party should carry the risk if it cannot be controlled;
* whether the premium to be charged by the transferee is likely to be reasonable and acceptable;
* whether the transferee is likely to be able to sustain the consequences if the risk occurs;

As a general principle, it is unwise to try to pass to the contractor a risk which is difficult to assess. Conscientious and skilled contractors will increase their prices substantially to deal with them. Unscrupulous or careless contractors will disregard these risks when preparing their bids and will consequently find themselves in difficulty at a later stage. Once this happens, they will try in one way or another to pass the cost back to the client. If this fails, they may even be forced into liquidation, which will not help the client at all.

2.6.4. Risk Retention

As a general principle, risks which are highly unpredictable and poorly defined should be carried by the client (Murdoch and Hughes, 1992), because the alternative will be tenders which are so inflated as to be unacceptable. Examples of such risks are those associated with pure risk, such as war, earthquakes, invasions, and so on, which would be impossible to quantify or predict.

Speculative risk that cannot be avoided or transferred to another party are generally retained by the contractor and may or may not be controlled by him. Even when control and risk reduction is possible there may still be some potential hidden risks and the contractor should try to reduce the likelihood of occurrence of such a risk event and to minimise the effect if the event occurs. For those risks that are uncontrollable, there is nothing more that can be done, except the careful analysis of them and the greatest attention to them.

However, in both cases, the construction firm is faced with a residual risk and it is normal in construction projects for this to be represented in monetary terms by a risk allowance or contingency fund. The amount of risk allowance is traditionally set by using an arbitrarily chosen percentage of capital expenditure (Perry, 1985). With the risk analysis methods available (Yeo, 1982; Inyang, 1983), however, the risk allowance (or contingency fund) is widely calculated in a group of possible values or a distribution form. The contingency for uncontrollable risks should be taken into account for the purpose of pricing the bid. The actual value of contingency should reflect the likely claims consciousness of the builder and his level of appreciation of the risks allocated to him.

2.7. THE ROLE OF RISK ANALYSIS IN CONSTRUCTION PROJECTS

The role for risk analysis can be particularly important in construction projects that involve more than one organisation or contracting party. In such projects, risk analysis may be performed by any contracting party, each with their own perspective of the project and its attendant risks. Generally, risk analysis should be undertaken by both the client and the contractor. This should involve, at an appropriate level of detail, the systematic identification of sources of risk, the specification of the uncertainty associated with each source of risk, the assessment of appropriate responses, and the assessment of the consequences for the cost, time and quality aspect of project performance (Ward and Chapman, 1991). In addition, risk analysis should be used to determine how risk should be allocated to contracting parties. An analysis of risk should strongly influence the choice of method of payment and form of contract. This is discussed later in Chapter Three. In short, the quality of construction project is improved if risks are analysed and evaluated in a systematic way.

2.7.1. Analysis by the Client

Risk analysis by the client should be undertaken to reduce uncertainty and risk, to pursue risk efficiency, and to check the risk/expected-cost balance (Ward et al, 1991). Risk analysis allows project risk to be divided into four identifiable sets of sources of risk: one controllable by the client, one controllable by the contractor, one controllable by both, and one controllable by neither. More generally, risk analysis can be used as a basis for the efficient allocation of risk without the constraints of a simple fixed-price or cost-plus contract.

One problem is that, even with the help of advisers, the client may not be in a position to assess many of the risks associated with the project. Such risks may be better assessed by potential contractors. Unfortunately, in current competitive-tendering practice, it is not usually possible to tap this source in such a way as to materially influence the basic form of the contract. Yet the form of the contract will motivate the contracting parties to address the management of risk to a greater or lesser extent (Ward et al, 1991).

2.7.2. Analysis by the Contractor

Risk analysis by each bidding contractor could be based on the client's risk analysis if it were provided in the tender documentation. The greater the detail provided by the client in relation to risks that are to be borne in whole or in part by the contractor, the less the contractor has to price for risk related to the contractor's uncertainty about what the project involves.

A likely obstacle to the transfer of information from client to potential contractor is the client's perceived vulnerability to legal action in respect of alleged errors or misrepresentations in information. This may hamper the transfer of stochastic information, for example about ground conditions in a construction project.

The role of the bidding contractors' risk analysis is quite different to that of the client's. Each contractor wants a bid that gives an appropriate balance between the risk of not getting the contract and the risk associated with profits and losses if the contract is awarded. The risk implications of bidding are discussed in Chapter Five.

2.8. RISK ALLOCATION IN CONSTRUCTION PROJECTS

Careful risk analysis for a construction project should lead to the selection of the right allocation of responsibilities, type of contract and tendering procedure. The most challenging of these tasks is deciding what is the equitable risk allocation. But if any of us has a choice between responsibility and survival, of course it is survival that usually will win (Abrahamson, 1984). That is why, for all its faults, a legal framework is necessary.

It is well known that the allocation of risks in a construction project to contracting parties have a substantial impact on construction performance. Raftery (1994) has stated that the starting point for the distribution of risk is the contract. The purpose of the contract is to establish the rights, duties, obligations, and responsibilities of the parties and to allocate the risk (Flanagan and Norman, 1993). Proper allocation of risk must consider the ability to absorb the risk and the incentives being offered to carry it. Generally, risks are allocated to the parties best able to control them, and parties who are expected to bear risk receive adequate reward for doing so. A dominant party unthinkingly offloading all the project risks to others is unlikely to enhance the chances of a successful outcome to the project.

Abrahamson (1973 & 1984) has suggested that it is proper for a contracting party to bear risk in any one of the following five cases:

* If the risk is of loss due to his own wilful misconduct or lack of reasonable efficiency or care;
* If he can cover a risk by insurance and allow for the premium in settling his charges, and it is most convenient and practicable for the risk to be dealt with in this way;

* If the preponderant economic benefit of running the risk accrues to him;
* If it is in the interests of efficiency to place the risk on him;
* If, when the risk eventuates, the loss happens to fall on him in the first instance, and there is no reason under any of the above headings to transfer the loss to another, or it is impracticable to do so.

Successful, appropriate allocation of risk along the lines proposed by Abrahamson presupposes an atmosphere of trust between contracting parties, and a clear, mutual appreciation of all relevant project risks and their effects. In the absence of one or both of these conditions, and given the limitations of these guidelines (Ward et al, 1991), it is perhaps not surprising that the debate about appropriate allocation of risks is often diverted to the investigation and clarification of the effectiveness of allocation mechanisms such as contract clauses (Beard, 1982). In spite of the allocation of risks through the contract any significant default by the contractor remains the client's risk (Perry and Hayes, 1986). It is apparent, therefore, that the client's budget must be based upon an estimate of the final achieved cost of the project including allowances for risks which the bidders may not have included in their tenders.

Risk is best managed through allocation of those risks to the party who has the best chance to control and minimise the risk. If the risk is imposed on a particular party, an opportunity for reward should be available (Manzi, 1985). This concept is a fundamental cornerstone of construction contracting. Naturally, the element of control is associated with a state of circumstances and cannot be looked at in isolation. So, when that state is altered as a result of some intervening act, it cannot be said that the original risk bearer is still in control. He should then be allowed to transfer any adverse consequences of the intervening act to the party causing the act.

2.8.1. Willingness of Parties to Take on Risks

A very significant factor of risk allocation is the element of control available to the parties who are required to bear the risks. However, the willingness of parties to take on risks is also an important consideration in the allocation of construction risks. Contractual allocation of project risks is essentially in the hands of the client. If the client is unwilling to bear a particular source of risk, he can pass this on to one or more of the other parties involved in the project, including the management contractor in a management contract if he so wishes (Murdoch and Hughes, 1992). Of course, the client will pay a price for passing on this risk.

Where a professional or contractor is aware that he will be required to bear a given type of risk, professional fees and tender prices will include an additional premium to reflect the expected cost of this risk, plus a contingency sum in most cases, plus a fee for the risk-bearing service. To the extent that a professional or contractor is unwilling to bear the given risk, a further increase in the premiums will be sought. These premiums are usually incorporated in prices tendered and represent a significant portion of the bids.

Generally, the willingness of a contracting party to bear risk is dependent on the factors listed below:

* general attitude to risk,
* perception of project risk,
* ability to bear the consequences of a risk eventuating,

* ability to manage the associated uncertainty and thereby mitigate the risk,
* need to obtain work,
* perception of the risk/return tradeoffs of transferring the risk to another party.

The willingness to bear risk is appropriate only insofar as it is based on a general attitude to risk, an adequate perception of project risk, a real ability to bear the consequences of a risk eventuating, and a real ability to manage the associated uncertainty. Willingness to bear risk may be inappropriate when it is due to inadequate perception of project risk, a false ability to bear the consequences of a risk eventuating, a need to obtain work, and a false perception of the risk/return tradeoffs of transferring the risks to another party.

2.8.2. Client Willingness to Retain Risk

Client organisations are often quite unwilling to carry construction risk. Moreover, clients have become increasingly influenced by their consultants in determining the allocation of risk in construction contracts. Not surprisingly, inexperienced clients are often advised by their consultants to obtain protection under their contracts for construction works. Usually, they draft contracts with special clauses appended that place some or all of the liability for cost and time overruns on the contractor. In any dispute, the special clauses would have taken precedence over the general clauses. Experienced contractors avoid such contracts, but others bid keenly for them, and then get into difficulties.

On the other hand, clients may be more willing to take on risk if they have experience of the construction industry and build frequently. The client who is habitually commissioning construction work will benefit considerably from a policy of allocating only a small amount of risk to the contractor. Of course, it may be argued that there is no reason why a client should carry project risks if he does not wish to do so, provided that he is willing to pay for the privilege.

Clients are the life blood of the industry. It should be recognised that there are two types of client, the habitual and the occasional, whose attitudes towards the construction industry are necessarily different (Barnes, 1983); this should be reflected in different risk allocation in conditions of contract.

2.8.3. Contractor Willingness to Take on Risk

The willingness of a professional, or contractor to bear a risk, as based on the factors discussed above in Sub-section 2.8.1., is generally influenced by the premium that they are able to charge for doing so. Inability to charge a sufficiently high premium, owing to market forces, for example, may render a professional or contractor less willing to bear a given risk.

As the managing director of a major contracting firm remarked in Curtis (1989) work, it is normal for the client to want a contractor to carry project risk, and, if the contractor is able to evaluate and price the risks, he may be happy to carry them. However, a contractor is often not able properly to evaluate and price risks. Even if the contractor is prepared to undertake appropriate analysis of project risks, lack of information about project uncertainties, and lack of time to prepare the tender, may preclude the proper evaluation of project risks.

In most cases, a project that may have taken several years to justify and prepare is parcelled up and handed to tendering contractors who are normally faced with a tender-submission deadline that only permits a scanty appraisal of the complex construction problems and risks involved. In the absence of adequate time and information, any evaluation and pricing of potential risk exposure is likely to be on an *ad hoc* and perfunctory basis. Few, if any, calculations or references to specific results on previous contracts are made, the rationale being that any such references are likely to be applicable to the circumstances of the contract in question. Whatever form of contract is adopted finally, a successful project requires that all parties involved understand and accept risks appropriately allocated to them, and that these risks are effectively managed. But this is a purely hypothetical situation (Bertinelli, 1985). Today, as a consequence of the contraction in the volume of work which is offered by the market, the major risk for many contractors is that they do not succeed in guaranteeing their own survival, and many are induced to accept contracts under any conditions.

2.8.4. Risk Versus Incentive

Risk and incentives go together. He who carries a risk has the incentive to minimise its impact. He who has transferred risk to another body has no incentive to minimise its impact (Barnes, 1983). It is consequently important that at least some risks should be allocated to contractors in order to sustain their incentive to achieve.

For example, on a cost-reimbursable contract with no penalties for late completion, a contractor has no direct incentive either to use resources sparingly or to maintain an appropriate pace of work leading to prompt completion. He has an indirect incentive only in the sense that his reputation may suffer if he performs badly. The reputation risk is the only one that a written contract cannot transfer from the contractor to the client (Barnes, 1983).

It is important that the contractor should carry some of the risks associated with cost and time. If he is absolved from all direct risks, it is inevitable that costs will be greater than they needed to have been and the pace of work will be slower. Where a contractor has a number of projects, some of which are risk bearing and some of which are not, it is unlikely that his most effective staff or best equipment will be allocated to the non-risk-bearing contract.

2.9. Contractual Risk and Murphy's Law

The term 'contractual risk' is about the unexpected such as floods, fire, changes in design, strikes, and so on (Murdoch and Hughes, 1992). These are events which it is hoped will not happen at all; however, if they do, then someone will have to bear the cost.

The key difference between economic and contractual risk is this: economic risk is about the determination and management of costs such as the purchase of materials with which to build, or the hiring of subcontracted labour. The point is that these things are undoubtedly going to happen; the risk lies in the uncertainty of the degree to which they will involve someone in expenditure.

Both types of risk are concerned with the eventual payment and responsibility for the cost. The main point about contractual risks is that the contract apportions these between parties. The contract may seek to transfer the risk by making the other party financially liable should the eventuality take place. In this way, risks are translated into financial equivalents, so that they may be transferred or otherwise dealt with. If the contract is silent on a particular risk, that risk will lie with one party or the other.

Clearly, contractual risk is to do with what happens when some mischance occurs. According to Murphy's law, if a thing can go wrong, it will go wrong. The point about contractual risk is that, if one is repeatedly involved in construction, anything which can go wrong eventually will. This is Murphy's law applied to construction. A client who only builds once may be fortunate enough to avoid some or even all of the risks involved. A contractor, architect or surveyor, on the other hand, is statistically bound sooner or later to meet some of these terrible disasters. It is this statistical inevitability that makes the consideration of risk distribution and the choice of contract so important.

To some extent, the consequences of Murphy's law can be mitigated by allocation of risks to other parties through careful contract drafting, by adequately insuring, by detailed planning, by judicious staffing, and by prescience and prognostication (Bruner, 1986). Beyond these mitigation measures, however, the fate of contractors who fail to perform their contracts due to encounters with the 'unexpected' well may rest in the hands of law and its doctrine of *force majeure*.

2.10. CONCLUSION

This chapter has discussed the concepts and principles of risk management in the construction industry. The key elements common to risk management are identified and defined as:

* risk identification
* risk analysis
* risk response

In this system, the task of risk identification is to identify all potential risks or uncertainties which can affect the project outcomes and act as constraints on the project. Risk analysis is the process used to quantify the effects on a project of the risks that have been identified. Some analysis techniques have been developed for this task and this chapter has described six: sensitivity analysis, probability analysis, decision tree analysis, Bayesian analysis, utility theory application and simulation approach. Careful risk analysis for a project should lead to the selection of the right allocation of responsibilities, type of contract and tendering procedure. These are discussed in the following chapters.

Risk response has been considered in terms of risk avoidance, risk reduction, risk transfer, and risk retention (or absorption). The greater the uncertainty associated with a project the more flexible the response must be.

Risk management is not new to the construction industry. The successful application of these sophisticated techniques seem, at present, to be restricted to large projects. Encouragement and promotion is still needed to ensure their general application in practice.

CHAPTER THREE: THE CONSTRUCTION INDUSTRY

3.1. INTRODUCTION

The preceding chapter was provided the general conceptual background of risk management in the construction industry. The focus of this chapter is the Construction Industry itself. It concentrates on describing the nature of the construction industry and its role in the economy. It examines the various definitions of the construction industry. However, because of the difficulty involved when separating the building industry from civil engineering, it is more realistic to use 'Construction Industry' to include both building and civil engineering works.

This also discusses the participants in the industry and the general features of its products, intended to show the inter-dependence of the participants and the complexity of the industry and its relation to other industries. Since various types of contract are used in the construction industry, this chapter also provides a brief discussion of the types of contract available. This chapter cannot cover every aspect of the construction industry. It covers the relevant aspects of the industry as explanatory variables in the risk perception of both buyers and sellers in the industry.

3.2. DEFINITION OF CONSTRUCTION INDUSTRY

Langford and Male (1991:17) have stated:

> "The construction industry is amorphous and diverse and as such it is difficult to define."

Defining the 'Construction Industry' is not a simple task, and different studies have used different definition according to their needs and aims. According to Robinson (1939) the industry is subdivided into 'Building' and 'Public Works Contracting'. 'Building' includes the erection and maintenance of houses, factories, and commercial buildings, including shops, offices, places of entertainment, railway stations, etc., while 'Public Works Contracting' includes the construction and maintenance of roads, bridges, canals, tunnels, harbours, etc., for local or central government. 'Construction' includes the erection of any structure or the alteration of the natural topography of the ground, and the maintenance and repair of such structures. Although Robinson has distinguished between 'Building' and 'Public Works Contracting', he maintains that the term 'Construction' can be used to refer to both. The Institute of Marketing's (1974:12) definition is:

> "That total industry which involves the utilisation of human, economic and natural resources in the conception, design, construction, maintenance or demolition of buildings and civil engineering works."

The Institute also acknowledged that the industry was made up of two basic parts - the building industry and the civil engineering industry. The building industry defined as being:

> "That part of the construction industry which is concerned with the design, construction, maintenance or demolition of all types of building."

The civil engineering industry defined as being:

> "Most of that part of the construction industry which is concerned with the design, construction, maintenance, or demolition of the economic

infrastructure of roads, and other communication facilities, and public utilities."

Although the Institute (1974:12) recognised the differentiation of the two industries, it acknowledged that -

> "There is no hard and fast dividing line between the two parts since, for instance, some building types are closely associated with, and usually form an integral part of, certain civil engineering works."

The Institute went further to note:

> "If some arbitrary division is needed, then it is suggested that the definition of a building (as used in the term building industry) be limited to the concept of a single structure, or related group of structures, constructed on a (relatively) confined site, generally excluding those structure which are ancillary to, or form an integral part of engineering works."

On the basis of this practical difficulty in separating the two parts, the term 'Construction Industry' has been used to refer to both building and civil engineering parts. The differentiation of the two industries is largely a matter of convenience. A more detailed list of specific works and activities is given in the *Indexes to the Standard Industrial Classification* (CSO, 1981). Even this listing is not complete, but it can be used as a point of reference in cases where doubt exists.

One difficulty about definitions is the construction industry's complex contractural and human relationships between and among its participants. The participants in the industry make decisions and perceive risks in the decisions they make or want to make. These participants then use risk-management strategies to eliminate or minimise the risks they perceive. Therefore, it is appropriate to focus on these participants later in this chapter.

3.3. IMPORTANCE TO THE ECONOMY

Fellows et al (1991) stated that building is strongly related to the state of health of the general economy and to the level of interest rates and business activity in particular. In any economy construction is a key activity. It influences the final flow of goods and services produced in the economy. The construction industry has a greater effect on the environment than any other industry (Hillebrandt, 1984). The importance of construction in the economy stems from three characteristics (Hillebrandt, 1985):

* its size
* it provides investment goods
* government buys much of its work

3.3.1. Economic Size

There are several ways to measure the size of the industry but two of them: the manpower of the industry, and the total value of goods and services produced are most significant. Indeed, the 170,000 heterogeneous and fragmented firms undertaking some £40 billion of work each year make the construction industry an important economic entity (Langford and Male, 1991).

The British construction industry is large in terms of both output and employment (Langford et al, 1995). Around a million and a half people in the United Kingdom were estimated to work in construction in the mid-1980s.

In 1983, its employment was nearly three times that of the agriculture, forestry and fishing industries, over three times that of the mining and quarrying industries and about three times that of the gas, electricity and water industries (CSO, 1984). In the boom years of 1987 and 1988 the industry could not find enough employees to cope with the workload. Although in 1991 an estimated 100,000 jobs were lost since the start of the world-wide recession, the industry still keep a large amount of manpower involved in the construction activities (Chapman and Grandjean, 1991). In 1993, there were 1.4 million people working in construction (DoE, 1994).

In 1982 the value of the industry's net output in the United Kingdom calculated excluding supplies bought from other industries approach 6 per cent of the Gross Domestic Product (CSO,1983). The value of the industry's output in the United Kingdom in 1983 was over £24,000 million or around 10 per cent of the Gross Domestic Product (DoE, 1984). In 1991, it was over £43,000 million (DoE, 1992), around 8 per cent of the GDP (CSO, 1992). In 1993, it was £46,286 million (DoE, 1994). Currently, it is still producing approximately 7.5 per cent of the Gross Domestic Product and employing in the region of 1.5 million people - 6 per cent of total workforce approximately (Langford et al, 1995).

Internationally, construction is an important industry accounting for 3 to 10 per cent of Gross Domestic Product, less in developing countries than in developed ones (Wells, 1986). The size of the construction industry shows it's importance to the economy.

3.3.2. Providing Investment Goods

Another measure of the significance of construction to the economy is its contribution to providing investment goods. Construction is an investment-goods industry, its products are wanted not for their own sake but for the goods or services they can help create. For example a factory is used to produce other commodities.

Construction is an investment since its value is high in relation to the purchaser's income. For individual consumers, the purchase of a house will usually entail the expenditure of several times their annual income. Similarly, a manufacturing firm's factory will be a large expenditure in relation to the annual income it produces.

3.3.3. Government Role

Successive governments have generally exacerbated the building demand fluctuations by using the industry as a regulator for the economy. This has been achieved by direct intervention as a major client for the industry, and indirectly through the manipulation of interest rates to control private sector building demand. In addition, there has been the increasing regulation of building standards and land-use through building regulation and planning legislation (Fellows et al, 1991).

The importance of the public sector as a client of the industry has far reaching effects on the industry and the economy. Public construction makes up a significant portion of total annual construction expenditures in almost every country. Government has the means to exercise a very direct control over the level and nature of demand. Some work is performed by the public sector itself, sometimes through state corporations. Some developed countries have public sector organisations undertaking work.

Since government institutions - central, local or quasi-governmental - are responsible in most countries for providing of infrastructure, the role of the public sector as a client of the industry in developing countries is greater than in developed countries. Even in developed countries the governments' activity is high - sometimes over half the new construction. In the United States, approximately 25 to 35 percent of all annual construction expenditures are for public construction (Adrian, 1981).

In the UK the reduction in public sector work in house-building and civil engineering has been noted. Since 1973, public sector new housing and other new work have declined substantially while commercial building has increased dramatically (Hillebrandt and Cannon, 1990). By 1987, new work on behalf of the public sector had dropped to £4469 million, which represented 26 per cent of total new work (Hillebrandt, 1985). In 1993, new work for public sector was £8333 million, which represented 35.8 per cent of total new work (DoE, 1994). Although government's involvement as a client, both direct (e.g. Local Authority Housing; road construction) and indirect (e.g. Hospitals, via the National Health Service), has diminished in the UK largely due to privatisation as a mainstay of policy, in the early 1990s, the public sector was client for around 35 per cent by value of the industry's work (Langford et al, 1995).

3.3.4. Importance of Three Characteristics

These three characteristics - its size, its production of investment-goods and its dependence on government - provide the key to the interrelationship between the industry and the economy. Size is important because changes in the output of the construction industry affect the size of the national product. It also means that what happens to the construction industry is a matter of national concern, it is too big and too important to ignore.

As a provider of investment goods, if the output of the industry is down, total investment is down. For most of its products will be required only if certain other factors are favourable, for example, the expected sales of the goods which the factory would produce; and the availability of mortgages for house purchase.

Lastly, the dependence on government as a client means that government is able to regulate demand on the industry by its own proposed projects, in addition its influence on overall investment through control of credit and interest rates.

The economic climate is a factor that may influence a manager's perception of risk in his decision making process. It is particularly true in the construction industry. However, the economic climate may not be a risk, but an uncertainty.

3.4. MAIN PARTICIPANTS AND THEIR FUNCTIONS

Construction involves many participants in a great variety of interactions and contractual relationships. This makes it particularly difficult to consider every participant connected with the construction industry. Therefore, only the main groups of participants will be considered. These include the:

1) Client, who could also be the user;
2) Design team;
3) Construction team;
4) Manufacturers;
5) Merchants;
6) Banking and financing institutions;
7) Public undertakings and authorities with statutory duties;
8) Education, Research and Development group;

Basically, groups 1-5 form the core of the construction process. However, the process of construction itself may be influenced by the other groups, particularly by the behaviour of groups 6 and 7.

This list indicates the wide variety of interactions possible. For instance government interacts with, and can be a prime factor in the activities of every other group. The influence of any of these groups of participants on the construction process therefore, depends a great deal on the functions/roles of the groups or an individual participant within the group.

3.4.1. The Client/User

Roles of Clients

The client, otherwise known particularly in contract documents, as 'the building owner' or 'the employer' has the most critical role to play in the production of the construction product (Moxley, 1993). For all but very small projects, the client is unlikely to be an individual (Langford et al, 1995). Possibly only in the case of a residence built privately for an individual can the client and the user be considered truly the same. Increasingly, the client is largely an agency for undertaking the construction work, and the users are other parties. In most cases, the client is the customer, the owner or his representative, of a construction project. The client plays an essential part in construction process in the sense that -

1) It is the client that initiates the project.

Since the client initiates the process, they have a crucial voice in the timing, location and pricing of the project.

2) The project itself is in most cases, 'designed to order', because there are few standardised

choices available to the customer, the client, in the same way as for most other goods.

The client appoints a design team for this purpose. However, there may be some exceptions such as in the case of 'all-in', 'turnkey', or 'design and build' contracts where this particular function may be delegated to the main contractor.

3) The client maintains strategic control throughout the project.

This control includes responsibility for selecting the design team and contractors, agreeing the design proposals, monitoring the progress of design and construction, providing prompt decisions as required and restricting to a minimum client-induced variations.

The client therefore is one of the most important participants in the construction industry, and his role in this respect has been recognised by various Government Reports, such as *The Public Client and the Construction Industries* (NEDO, 1975) and *Before You Build* (NEDO, 1974) - private client's guide. The Wood Report (NEDO, 1975), for example, stated that the key issues relating to the client's responsibilities as follows:

1) The nomination of an individual to co-ordinate client requirements;
2) The provision of a clear project brief to the design team;
3) Monitoring the progress of the design and construction teams and involvement in any major strategic decisions that may be required during the course of the design and construction phases.

According to the report, the client has a duty to establish his objectives clearly and monitor progress through design and construction. In other words, the client has a duty, not just to originate or establish his needs, but more so to take risk management measures to ensure that any inherent perceived risk does not prevent the achievement of the objective or the fruition of the idea - that is, the successful completion and delivery of the product or project.

However, important changes have taken place to the role of the client in the construction process during the 1980s. New procurement methods such as management contracting and construction management, project management and even design and build methods have imposed changes on the way clients organise their practices, as a result the client's role and influence has been diminished.

Types of Clients

Broadly speaking, construction clients can be classified into three groups:

1) The public client
2) Organisations
3) The private client

Public clients (government agencies) form the predominant number of construction customers, but are not necessarily the users of the construction projects. The public client category includes those concerned with the provision of infrastructure and other facilities used by the community as a whole but where the individual user is not charged, examples include roads, harbours, schools, defence installations, prisons, police stations, etc. In the United Kingdom in 1983, 36 percent of new work was for the public sector (DoE, 1983), and it was 26 percent in 1990 (DoE, 1991). Newcombe et al (1990) indicate that the public sector is the foremost client (by far) of civil engineering organisations; in building, there has been a marked downward trend in demand from the public sector, particularly since the late 1970s.

Organisations can be sub-divided into (a) commercial, (b) industrial, and (c) religious or social, each with differing roles and objectives. Many nationalised companies and corporations fall into this category although they may be subsidised by governments (Hillebrandt, 1985). Collectively, organisations as 'a group of clients', in the construction industry, are a force to reckon with, particularly during boom periods.

The private clients group primarily consists of owners of residential buildings. The private sector grew in 1988, the number of private sector housing starts reaching 200,000 for the first time, double the number of starts in 1980 (NEDO, 1988). The Housing Act of 1990 will further depress the role of local authorities in the provision of housing and seek to supplement this role with private sector landlords on large housing estates and housing associations who can attract private funds.

In most cases, the private client is also the user of the project which tends to be relatively small in money terms. However, there is another type of private client must be considered, namely the developer - who is a client of the industry only because he wishes to sell or let the completed building. In the United Kingdom, a great majority of private housing is constructed by developers.

The client is the first major participant in the construction process. The selection of the construction method, architect and his design team, cost controllers, project managers and contractors to be employed on the project is client's responsibility (Moxley, 1993; NEDO, 1978). Broadly, clients are either experienced or naive. Expert clients build often and know what performance can be demanded and how to obtain the required performance. However, the majority of clients are naive, they build very infrequently, know little of the industry and may be influenced easily - by advertising of the first contact with construction personnel. Hence, for naive clients, those who obtain first contact with them regarding a project are in a significantly advantageous position (Langford et al, 1995).

This broad classification of clients in the construction industry is intended to show that the influence of clients on other participants will vary. It depends on the type of client, and what their objectives may be.

3.4.2. The Design Team

The design function is concerned with preparing a detailed design brief, designing alternative schemes to meet the client's requirements, and producing the necessary information to enable the selected design to be constructed. The importance of a design team featured prominently in the Banwell Report (Banwell, 1967:4). According to the report,

> "A design and a programme of work are essential prerequisites to any construction project. For this purpose, it is usual to seek the advice of an architect or engineer (or both) as the case may require ..... But construction work is not as simple as it was. It is becoming increasingly more complicated and highly mechanised, and there are signs ... that in many modern building and civil engineering projects the advice and collaboration of a professional team is called for from the outset."

Accordingly, the design team is normally appointed by the client. It is difficult to generalise on the composition of the design team since membership tends to depend on specific contractual arrangements. However, two types of building designers can be generally described:

1) principal designers
2) specialist designers

Principal designers may either be architects or building surveyors. Usually, an architect is employed by the client to look after his interests and become his general agent for all purposes relating to designing and superintending the building of the work for which he has been commissioned (Calvert et al, 1995). The architect's role in times past was essential to the construction process. However, as a result of the increase in the relative strength of the main contractor under the latest form of JCT (Joint Contracts Tribunal) Contract, the client's role, and with that the architect's role and influence, has been diminished (Moxley, 1993).

Specialist designers are those who provide specialist design services. There are three groups of specialist designers: civil and structural engineers; services engineers; and other designers. Architects, structural (civil) engineers, services engineers and quantity surveyors are the usual consultants on a building project. Recently, further consultant titles have emerged, the most prominent being the Project Manager - someone who acts as the manager of the whole project for the client (Newcombe et al, 1990).

So, one would then expect the design team on a major project to include specialists such as civil and structural engineers, electrical engineers, heating and ventilating engineers, quantity surveyors, and other advisers required for the design, supervision, and control of the works. The names and addresses of architectural practices and the types of work they undertake are published by the Royal Institute of British Architects (RIBA) in its *Directory of Practices* (RIBA, 1990).

Normally, the design team is assumed to be divorced from the construction team. The architect has assumed a triumvirate of roles - designer of the building, manager/coordinator of the total design functions and manager/controller of the construction on behalf of the client. Engineers' roles have tended to be secondary - designing the structure and services for the building to suit the architect's overall scheme. The quantity surveyor provides cost advice during design, advises on contractual matters, produces a bill of quantities and provides post contract financial control.

However, in a 'package deal', 'turnkey', 'design and build', or 'all-in' contract, the design function and the design team, may be linked more or less closely to the construction team. In such a case however, the client may demand and get an assurance from the main contractor that adequate professional skill and care in design have been, or will be exercised to meet their requirements.

Important changes have taken place to the role of the architect in the construction process during the 1980s. New procurement methods have imposed changes on the way architects organise their practices. Clients are more often seeking 'one stop shopping' and so architects have combined, formally or informally, to provide multi-discipline practices which encompass the full range of expertise necessary for the erection of a building (Langford and Male, 1991).

3.4.3. The Construction Team

The physical on-site construction work is undertaken by the construction team. Like its counterpart - the design team - membership of the construction team also is subject to specific contractual arrangement. Basically, the construction team is made up of the main contractor, and specialist sub-contractors, other suppliers operating 'supply and fix' services, and some professional advisers who may belong to other groups. For instance, it is not uncommon to find the architect or engineer as members of both the design and the construction teams.

The main contractor is normally the person or organisation responsible for the construction works. However, the manner in which he can exercise this particular function may depend on the nature of the work, and the type of contractual arrangements. Normally, most main contractors would delegate or sub-let parts of the works to subcontractors. There may be some extreme cases - where the main contractor may carry out all the work himself, or reduce himself to a mere co-ordinator of the subcontractors who then, de facto, assume the responsibility for the whole work. As a defence against uncertainty of workload, economic slump and unstable demand, an increasing amount of building work is being undertaken by subcontractors (Langford et al, 1995). The days when contractors directly employed the various tradesmen required to perform all but specialist tasks have been superseded by the employment of labour-only subcontractors employed as and when required.

There are three types of main contractor, however the dividing lines between them are imprecise (NEDO, 1974).

1) general builders
2) general contractors
3) design and construct companies

General builders undertake a wide variety of work, but most firms concentrate on particular types and sizes of projects. They are usually based locally or regionally.

General contractors some of which operate at national and international levels, also undertake a wide variety of work, but often decline to take on smaller projects. The majority of the construction work in the United Kingdom is undertaken by a general contractor

(Ashworth, 1991). These firms, which will be public limited companies (plc), will vary in size, having from just a few to many hundreds of employees.

Design and construct companies undertake the responsibility for both the design and construction of a building project. Some larger general contractors and a number of specialised firms offer this service.

The important point to bear in mind here, is that, whether the main contractor is carrying out all the works himself, or merely co-ordinating the subcontractors, there is no doubt that the main contractor has an extremely important role to play in the construction industry. This is particularly true under the latest form of JCT Contract. The contractor now has the right to run the contract as he sees fit and to claim extra payments and extensions of time over a wide range of items. He has complete control over all the subcontractors and it has now become the custom to hold the 'real' site meetings with the subcontractors independently of the meetings on site with the architect and his design team, and the client. Over the years, as JCT edition succeeds JCT edition, so more and more of the risks inherent in the process of building have been removed from the contractor and have been placed on the client's shoulder - he who is least experienced and least able to assess them (Moxley, 1993).

3.4.4. The Manufacturers

Many raw materials (the natural resources), manufactured materials and components (materials inputs), and so forth, are used in construction, but are produced by manufacturers distant from the construction sites. Manufacturers consist of two basic types:

1) Those whose output is directed wholly or principally to the construction industry;

2) Those who belong essentially to another industry but whose products are also used by the construction industry.

Firms manufacturing electrical products are such manufacturers included in group (2).

Since construction is basically an assembly operation, and, bearing in mind the labour and weather problems possible on site, the trend in construction is away from 'on site production' by the construction team towards increasing use of materials and components from the manufacturer. Moreover, the trend towards 'pre-fabrications', 'industrialisation', or 'system building', in addition to components becoming more sophisticated and complex, has encouraged some manufacturers to start offering 'supply and fix' services as sub-contractors. In such circumstances, such manufacturers could be said to be participating in the construction industry both as manufacturers and as members of the construction team.

The contractor's source of supply for building materials may vary, but must in all circumstances comply with those specified in the contract documents, regarding quality and performance.

3.4.5. The Merchants

Merchants are essential and important participants in the construction process. Basically, they are stockholders for the large volume of materials, components, fittings, and other items required throughout the life of a construction project. They act as intermediaries between the manufacturers and the construction team. In addition, they provide short-term credit facilities to the contractor or other members of the construction team.

Other essential functions they provide are the dissemination of valuable technical and commercial information to design and construction teams. With the trend away from on-site production, some merchants have begun to circulate contractors with the offer of 'supply and fix' services, either of manufacturers' products or those made by themselves.

3.4.6. Banking and Financing Institutions

This group of participants includes all sources of finance for the construction industry, both during the construction process and during the subsequent life of the building or works. In many cases, the client may provide the main source of finance especially for public clients. In any case the financing of construction projects tends to be issue-specific and therefore depends on the wording of the contract, the nature, and the magnitude, in terms of both the costs and size, of the construction project involved.

The banking and financing institutions are sometimes described as the 'life-blood' of the construction industry - in the sense that without their support, most of the activities of the construction industry would be paralysed. This assertion has been supported by various research findings on the causes of failure in the construction industry (Banwell, 1967). In addition, the history of the development of Building Societies in Britain shows how vital the financial institutions were, have been, and still are, in the proper functioning of the construction industry (Bowley, 1966).

3.4.7. Public Undertakings and Authorities with Statutory Duties

These include the suppliers of public utilities and services such as communications, electricity, gas, water, etc. A completed construction project, particularly buildings, that have no vital utilities cannot in a real sense, be described as 'a finished product'. To this end public undertakings ensure that proper public utilities and services are supplied to construction projects either during the process of construction, or when the project is finished or both.

Some of the public undertakings have some statutory or mandatory control over the way their services should be provided and utilised. In some cases, however, they may offer to participate directly in a construction project by sub-contracting for the supply, fixing, and connections of utilities and services to the construction project.

Apart from this, some public undertakings have some statutory duties to protect both the public, the workers within the construction industry, and thus, to some degree, the industry itself. It is hoped that this may help the industry to develop healthy relationships among its members on one hand, and between the construction industry and the public on the other.

Thus Public Health Acts, Building Regulations, Safety Regulations, and so forth, which are enforced by the relevant departments at both central and local government levels, are all intended for the benefit of the public, the customer, and the industry itself.

3.4.8. Education, Research and Development Group

As far as the present, and future needs, trend, and requirements of the construction industry are concerned, this group has some of the most essential roles to play in the construction industry. Included in this group are all educational institutions and those involved in the training and development of human resources for the benefit of the industry. Through education the risk of wasteful resource allocation is reduced. The group also includes those engaged directly or indirectly in researching, analysing, and forecasting the social, technological, and economic needs of the construction industry, and then ensuring that these needs are fulfilled.

It has been estimated that expenditure on research and development in construction, including project-oriented research, was £100 million in 1981 split about equally between public and private sectors (CIRIA, 1981).

In a review by Beacock et al (1989) into the characteristics of degree courses in higher education for the construction professions it was observed that management was identified as an area of deficiency by employers in all disciplines. The researchers also show that 45% of all construction graduates are civil or structural engineers and this implies that the management health of the construction industry will respond significantly to any improvement of university management syllabuses. Smith and Miquel (1991) also emphasise the need for more management education for civil engineers for the undergraduate and postgraduate degrees, especially the area regarding human resource management. They maintain that education processes that develop their skills in the work place are as crucial as those that develop the theoretical basis of human resource management. One important point should be noted here: in essence, the functions/roles of the Education, Research and Development Group, can then be felt in the construction industry as a risk reduction measure when more management training is given.

We have described each of the eight groups of participants in construction. It must be pointed out though that the classification of participants into functional groups is not exclusive. There may be occasions when members of one group are involved in the activities of other groups. With this background, we can now consider the features of the construction industry, in which the participants function.

3.5. MAIN ATTRIBUTES OF THE CONSTRUCTION INDUSTRY

For the purpose of this discussion all construction projects such as roads, bridges, ports, buildings, and so forth, are defined as 'Construction Products'. Like any other industry, the construction industry also has its own specific features. These features are reflected in -

1) the activities of the participants in the industry, and
2) the nature or characteristics of construction products.

Since the participants have already been discussed, this section will concentrate on the nature of construction products. The main attributes of the construction product are summarised as follows:

1) Dependent on land, and in almost all cases, also fixed to the land;
2) Unique;
3) Heavy and bulky;
4) Long production time;
5) Durability;
6) Expensive;
7) The divorce of design from production;

3.5.1. Dependent on Land

Land perhaps is the most common, but also the most important attribute of the construction product. It is the most visible in the sense that every one can see a building standing on a piece of land, or a motorway on a stretch of land. It is most important in the sense that virtually all construction products, with the exceptional and negligible cases of offshore fabrications, are fixed to the land. Hislop (1971:69) has reinforced this point by pointing out that -

> "Whatever degree of prefabrication is achieved there will be some need for stability fixings to land and for services connections to points below the surface."

Two main implications seem to emerge from this attribute:

1) In the first place, it implies that most construction products are made on their sites.

This in itself, has created following related problems: The first one is that the required materials or parts must be transported to the site with obvious transportation and storage cost implications. The second problem is that unfavourable weather or site conditions could adversely affect the completion date, which may have financial repercussion on the company. The third problem is that the separation of the site, where the work itself is being undertaken, from the headquarters or office from where the directives, and the required resources for the project must come, could create some confusion, frustration, and other associated problems which may lead to delays.

2) Secondly, it raises the question of land utilisation.

It seems that any increase in demand for construction products implies an increase in demand for land. The result is that the amount of land consumed maybe far greater than that can be available. This causes the rapid increasing of the price of land and the use of agricultural land and countryside for building. From the industry's point of view, there should be a continuous flow of land, with more than is immediately required already in the pipeline. However, clearly the environment needs protection and there must be regulation of the use of land. The long term future of the construction industry therefore, seems to depend on availability of land and how efficiently land is managed for this purpose.

3.5.2. Unique

In general, most construction authors agree that, although one building, for example, may be similar or identical to another, the process through which, and the conditions under which, the design is converted into a physical structure, involves a lot of factors that tend to vary with projects. Barda (1991:27) has noted that -

> "The conception, planning, design and construction of each structure is a set of unique interrelated processes. Each finished product is unique."

Morris (1979:159) also states that -

> "Although the typical form of work in the industry is a project, this is often only concerned with doing new things in a very literal sense. The sites are new, the faces in the labour force may be new, the client is perhaps new."

Similarly, Maher (1982) has also stated that no two construction projects can be identical in either form or construction. Moxley (1993) also indicates that few buildings nowadays are regular repeats. It could however, be argued that in some cases, such as construction of houses, this uniqueness may be greatly reduced, especially where the houses are all on one construction site.

The combination of the requirements of the client with the limitations imposed by site, local materials, prices, the abilities of the designer and the contractor, and other factors, has always tended to produce a unique result. It is this variability that distinguishes the construction process from other manufacturing processes which mass-produce their products in a standard form.

The uniqueness of construction products, particularly the one arising from the individual client's desires, is supported by the fact that most construction projects are legally sold before they are, in fact, made - a reversal of normal manufacturing practice (Fellows et al, 1991).

In other words, the medium of producing most construction products is the 'contract', which does not only establish binding obligations, but also forms the basis for its performance.

Because some construction products take a long time to complete, by legally selling the construction product before it is physically made, the possibility of losses on the part of the construction company arising from changes in the client's taste or needs, is eliminated or minimised. However Hislop (1971) has argued that the advent of modern building technology and standardised systems of construction may reduce some degree of uniqueness in construction products, and allow many arrangements to suit different needs and tastes.

3.5.3. Heavy and Bulky

By comparison with most other products and industrial durables, construction works are large and heavy. This attribute however, is assisted by the dominant position of land in the construction industry. The implications of the attribute therefore are the same as those of the land which being discussed in Sub-section 3.5.1.

3.5.4. Long Production Time

The production of most durables is reckoned in hours, days or weeks. By comparison, most construction products take a relatively long time to produce.

It is recognised that for a truly innovative industrial product the overall time required for its production may be long, especially if the time from idea generation to the actual production of the product is considered. However, once the production starts, it is possible to develop a learning curve, and so make use of the economies of repetition in a controllable and properly housed production line (Cafarelli, 1980).

In the case of the construction product, the situation is different. In the first place, the effects of land as the dominant attribute of construction products have already been noted.

Secondly, the fact that most construction products are 'unique' seems to suggest that the benefit of economies of repetition may not be realised in full, if at all (Calvert, 1986).

Thirdly, during the time the building or engineering work is incomplete, and before that during design, there are so many things to be done by so many different people, and there are so many opportunities for delay that there seems no tangible reward in isolating one of them and dealing with it (Hislop, 1971). The result is that, it takes a long time before the product may be finally ready.

Many of the difficulties and criticisms of present practices and procedures arise from the fact that insufficient regard is paid to the importance or value of time and its proper use in all aspects of a construction project, from the client's original decision to build, through the design stages and up to final completion. Time well spent can mean time and money saved. Modern techniques of planning and scheduling should be used to provide an overall discipline for all concerned.

3.5.5. Durability

Most construction products last for a long time. Some buildings or bridges built centuries ago are still in good use. However, Hislop (1971) has pointed out that, to some extent, the long life of construction products, such as ports, and so on, could be 'a disadvantage' in the sense that the process of innovation in the construction industry may be delayed, and the demand itself affected. Therefore, there is the temptation on the part of the sellers to shorten the lifespan of the products if this would help increase the demand for the products.

However, it is also recognised that, while a deliberate policy of 'built-in obsolescence' in the construction products could increase the size of the industry and keep demand afloat, such a policy could also increase the probability of legal liability for construction companies. Besides, doing this without the use of an alternative cheaper and better method of construction than used at present, could perhaps increase the cost of construction out of all proportion.

The end result will be that the customer will lose both ways in the sense that he will be paying more money for a less durable product. Faced with this dilemma, recent research has nevertheless, been geared towards finding new methods of construction which will reduce the cost of producing construction products without necessarily reducing the quality or life span of construction products. The advantage of this seems to be that the general reduction in cost of production may enable more people to afford the price of some construction products.

3.5.6. Expensive

Most construction products are expensive. The attribute itself seems to have originated from, and been reinforced by the fact that some construction projects, such as ports, motorways, buildings, and so forth, are really large. Many authors, Bowley (1966), Brech (1971), Jepson and Nicholson (1972), and Hillebrandt (1985) have pointed out that they involve correspondingly large sums of money.

This brings us back to the issue of risk perception by decision makers. We may recall that decision maker's perception of risk is influenced by the magnitude of the expenditure involved in the buying decision. This would imply that since most construction products are expensive, the perception of risk by those involved in the buying/selling decision process will be high enough to make them take some appropriate risk management measures.

3.5.7. The Divorce of Design from Production

Technically, it could be argued that design is part of production. However, 'production' is used here to mean the conversion of drawings into physical shapes or structures, such as buildings , and so on. Langford and Male (1991:18) have stated:

> "Despite the changes which have taken place in the construction production process, the tradition of design as a separate entity from production remains."

Apart from some 'turnkey', 'design and build', or 'all-in' contracts, most designs for construction are undertaken on the instruction of the client by the specialists, architect or designer, who may have nothing to do with the final production of the product itself. This separation of the vital participants of the construction industry has been the concern of a number of government reports and construction authors. For instance, one of the most important observations made in the Banwell Report (Banwell, 1967:1) was that -

> "The various sections of the industry have long acted independently."

The Report therefore recommended that this should be eliminated or at least be reduced because -

> "We consider that the most urgent problem which confronts the construction industry is the necessity of thinking and acting as a whole."

To justify this recommendation the Report pointed out that to call in a contractor to a site on which a complicated scheme - the planning of which may have taken months or even years - is to be executed, and to expect him to be able to make himself thoroughly familiar with his task and to settle the right way in which to do it, when work must start within a few weeks or days, is unreasonable. Wells (1986:68) also has expressed some concern about the separation of design from production, and maintained that -

> "It has led to a certain amount of isolation of the professionals from technical developments in the construction industry .... Consequently, the product may well be designed without sufficient knowledge of construcion, or of alternative construction materials and techniques."

Wells (1986:69) also maintained that -

> "The architect or engineer is isolated from a knowledge of actual production costs and of the costs of production based upon alternative designs."

In regarding the divorce of design from production, Bowley (1966) also has maintained that integration of the two functions is necessary for efficiency, innovation, and technical progress. Thus, as far as Bowley and Wells are concerned, the separation of design from production of some construction products may not be in the overall interest of the client and creates risks.

Fellows et al (1991) indicated that economic pressures in times of recession have weakened this dichotomy with design and production organisations seeking to diversify their operations by offering a wider service. Whatever the argument, the important thing to bear in mind is whether the interest of the client has been or may be affected by this division which may also have some adverse spillover effect on the construction company.

Traditionally, responsibility for design and construction has also been divided, the former allocated to the client's architects/engineers and the latter to the contractor; however, if one entity is responsible for both, then the client need look to only one party for design, supply, construction and commissioning obligations (Cahill, 1990).

3.6. TYPES OF CONSTRUCTION CONTRACT

Smyth (1985) states that the industry's most conspicuous characteristic is contracting. Raftery (1994) also emphasises that the starting point for the distribution of risk is the contract. Construction companies produce their products when they are awarded a contract. It is the contract which defines how the various authorities and responsibilities are shared between the parties. Although construction companies or contractors are responsible for the construction under the contracts they are awarded, they are unlikely to undertake all the work, subcontracting many of the skilled and specialist jobs out to other companies. Indeed, most, if not all, of the work is subcontracted in many contracts. The choice of type of contract is no doubt a dominant process of the construction industry.

The choice of type of contract for the employment, by the client, of those external firms is one of the most strategic decisions, since it governs the method by which the contractor will be paid and provides an overall statement of intent as to how the risks are allocated between the parties. In addition it has major implications for flexibility, incentive and the nature of the interaction between the parties.

However, the discussion here is not intended to be a detailed treatment of the contract strategies and contract procurement systems. Such details are covered in works by Porter (1981), CIRIA REPORT 85 (1982), CIRIA REPORT 100 (1983), Perry (1985), Gray (1985), and Gould (1985). The discussion is primarily concerned with the types of contracts used in the construction industry.

In the construction industry contract types are primarily distinguished by their payment systems. Four main types can be identified (Perry,1985; Gray, 1985):

1) Lump Sum
2) Admeasurement
3) Cost-Reimbursable
4) Target Cost

Generically it is possible to classified these into two distinct classes:

1) Price-based: Lump sum and admeasurement.

Payment is based on prices or rates submitted by the contractor in his tender. These prices are deemed to include all costs, overheads, risk contingencies and profit.

2) Cost-based: Cost-reimbursable and target cost.

Defined Actual Costs incurred by the contractor are reimbursed and in addition a fee is paid. The fee is deemed to include those costs which are not defined as reimbursable, plus overheads and profit.

It should be noted that the term 'type of contract' has been chosen carefully. Within the industry this term is quite commonly used interchangeably with the term 'form of contract'. Such usage tends to confusion since the term 'form of contract' has a contractual meaning, that is it refers to the document containing the conditions of contract. For example, *Conditions of Contract and Forms of Tender, Agreement and Bond* (ICE, 1986) is a form of contract.

3.6.1. Lump Sum

A lump sum or the fixed-price contract has been used for many years and is popular in the USA because of the necessity of the civil engineer in America finalising all the details of the work at the tender stage (Haswell and de Silva, 1982; Wundram, 1979). This is a highly commendable discipline but, unfortunately it has not extended to the UK.

A lump sum contract requires the client and his professional team to provide complete detailed plans and specifications describing methods, materials and standards at the tender stage. Therefore, the lump sum method of construction contracting is usually used when design is complete and little or no change is envisaged at the tender stage. Thus it imposes a discipline on the client to avoid, or at least minimise, the initiation of design changes during construction.

Lump sum contracts may also be used for construction packages especially in the building industry. Again the implication for the client is that he must define his conceptual, outline or scope design in the fullest detail possible and be prepared to avoid initiating significant change.

In the nature of construction change and variation may arise from sources external to the client or his design team, for example, unforeseen ground conditions, extremes of weather, supplier delays, national strikes. The client must therefore plan for the management of these risk events if they occur.

For the contractor a lump sum contract requires that he allows in his price for all risks imposed by the contract. This implies the lump sum is also used when the level of risk is low and quantifiable. A contractor's opportunity to maximise profit derives from his ability to reduce costs by planning the most efficient use of resources and exercising good control. He will expect minimum interference from the client and would be expected to claim for additional payment/time in the event of change or disruption initiated by the client.

Lump sum contracts are normally let by competitive tender. In practice which is relatively well known and straightforward a high degree of competition can be expected. However this can work to the potential disadvantage of the client if there are a large number of bidders. In these cases the client may find it difficult to verify the realism of the low bidder due to the small amount of data which contractors are required to provide with lump sum bids.

3.6.2. Admeasurement

The fundamental feature of an admeasurement contract (alternatively known as a measurement, remeasurement, or measure-and-value contract), is that the project is broken down into its constituent components (Williams, 1992). Another inherent feature of admeasurement contracts is that they provide for variation and change during the construction period. The conditions of contract therefore include various clauses which enable payment and the contract period to be adjusted accordingly. However, while such clauses typically define the circumstances under which variations may be valued, and also the contractual procedures to be followed by the parties, they do not specify a systematic approach to quantifying the valuation. Furthermore the bills of quantities and other contract documents are often deficient in this respect. Consequently valuation of admeasurement contracts can be a complex and drawn-out process.

In the admeasurement contract, the risk of variation in the quantities which are shown in the bill of quantities lies with the client, while the risk of inaccuracy and insufficiency of the unit price is borne by the contractor (Bertinelli, 1985).

An admeasurement contract is used when design is complete at the tender stage but changes in quantity are expected or when design and construction need to be overlapped. In practice it is recognised that there are limits to the extent of change which this type of contract can accommodate without severe strain. Perry and Thompson (CIRIA REPORT 85, 1982) suggested 20 percent of tender total as the limit of change which the admeasurement contract can reasonably accommodate, but the normal conditions used on civil engineering work in the UK do not contain such a restriction (ICE, 1986).

In an admeasurement contract the final price is invariably different from the tender total. This is an inevitable consequence of remeasurement, change, variation and delay. When there is major disruption there is a strong likelihood of drawn-out disputes over claims and the settlement of the contract price may be delayed for several years. Finally, it should be noted that there is no certainty in an admeasurement contract that the lowest tendered bid will yield the lowest final price.

Admeasurement contracts allocate both more risk and incentive to the contractor to complete the works efficiently (Ashworth, 1994). Admeasurement contracts, like lump sum, are normally let by competitive tender. In the building industry two-stage tendering has had some use as a means of achieving greater overlap of design with construction. Tender evaluation is usually more complex than for lump sum since a greater amount of data is provided by the contractor. Contractors are normally required to provide a method statement and programme and may be asked for data on resources and their estimated productivities.

3.6.3. Cost-Reimbursable

The cost-reimbursable contract has been known in the past as a cost plus contract and in earlier days by the much more elegant form 'time and lime contract' (Haswell and de Silva, 1982; Haswell, 1985). A cost-reimbursable contract is cheaper to prepare than lump sum contract and generally take less time (NEDO, 1970).

A cost-reimbursable contract places no requirement on the contractor to provide a price for the works at tender stage. Consequently the contractor can be employed early in the design process either to contribute to design or to make an early start to construction. In either case there will be a necessity for closer collaboration between client and contractor than on a price based contract.

The client will always pay the Actual Cost of work undertaken, plus a percentage (or fixed amount) fee for the contractor. However, the final price depends in part on the extent of change. Clients should therefore guard against making frivolous design change. On the other hand the contract is extremely flexible and, through collaborative planning and openbook accounting, there is the opportunity to consider fully the realistic impact of change before it is implemented and then to minimise its impact.

Also the final price will in part be dependent on the efficiency of the contractor. While contractors may argue that their reputation will suffer if they are significantly unproductive. In consequence the final price can never be regarded as certain until all work is complete and, on a cost-reimbursable contract, there is rarely a reliable forecast of final price at the tender stage. However the final price is known almost immediately after work is complete, unlike many admeasurement contracts.

The cost-reimbursable contract is only used in unusual circumstances such as (Wundram, 1979; Perry, 1985):

* When unusual or particular skills are required and there exists little opportunity for competition among contractors;
* Post-disaster clean-up and repair such as after a major fire or flood;
* When there is a need for an early start to construction and little design is complete;
* When the work is innovative and productivities are unknown, for example, involving research and development;
* When the client wishes to be closely involved in the management of the project or in industrial relation.

Cost-reimbursable contracts have been let as the result of a competitive tender but the extent of financial competition is inevitably limited to the fee. In many cases clients prefer to negotiate with one reputable and trusted contractor whom they know. In either case it is essential that the selected contractor can give proof of relevant experience of the type of work and experience on reimbursable contracts. He should also be expected to demonstrate the management procedures he intends to adopt and the client should ensure these are compatible with his own.

3.6.4. Target Cost

The target cost contract remedies the principal weaknesses of a pure cost-reimbursable contract by imposing an incentive on the contractor to work efficiently. The target cost also provides a basis for predicting the final price.

The essential elements of target cost mechanisms are the target cost, the target fee (which is the sum payable for overheads and profit if the actual costs equal the target cost) and the share formula (which determines how any underrun or overrun of actual costs against the target will be shared). Upon completion of the work, the contractor's fee is increased above the target fee if the actual cost is less than the target cost, and the fee is decreased if the actual cost exceeds the target cost. But the contractor will not incur a loss since he will be reimbursed by the client for the costs incurred (De Benedictis and McLeod, 1973).

In a target cost contract timely completion at minimum cost will be achieved mainly by active collaboration between the parties and continuous planning of the deployment of expensive resources. All parties will be aware of the Actual Cost of all construction activities and can therefore contribute towards minimising costs. Various methods for the appointment of the contractor have been used in target cost contracts throughout the world. The main criterion is the level of definition of work at the time the appointment is to be made. Three broadly classified methods are as follows:

1) Detail well defined

Here a bill of quantities can be used. Contractors cost the bill of quantities and specify their fee in a competitive bid. The tendered target cost of the successful contractor becomes the contractual target cost.

2) Detail partially defined

Again, contractors bid competitively on target cost and fee. In this case if a bill of quantities is used it will only be partially complete and need contain only major items. The final tender target cost is negotiated as design packages are completed during construction.

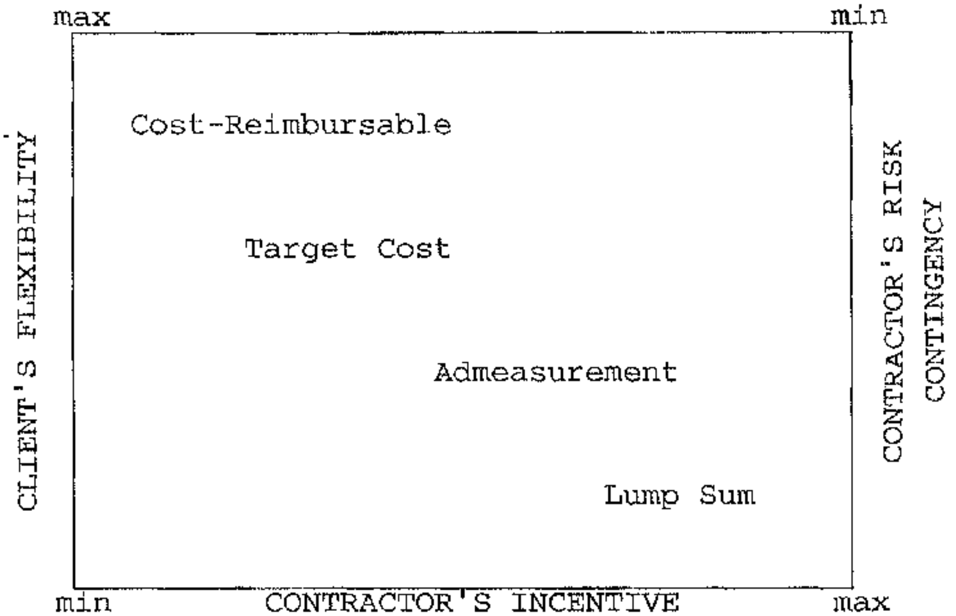
3) Scope defined with no details

In this case many clients prefer to negotiate with one reputable and trusted contractor whom they know and who has the requisite experience, expertise and resources.

3.6.5. Factors Affecting the Choice of Contract

Perry (1985) recommends that the appropriateness of the provisions for flexibility, incentive and risk allocation should be considered as main factor when choosing construction contract. The inter-relationship of these requirements with the type of contract is demonstrated in Figure 3.1. The requirements are expressed in terms of contractor's incentive, client's flexibility and contractor's risk contingency. It is generally apparent that the contractor's incentive and client's flexibility tend to be incompatible. With the client and contractor maintaining opposing financial interests, both parties must take considerable pains to protect their positions about the choice of type of contract.

Figure 3.1. Characteristics of Construction Contract



For example, a lump sum contract imposes maximum incentive and risk contingency on the contractor but also implies a very high level of constraint on the client against introducing change. A major characteristic of the lump sum contract is that a contractor agrees to perform the work at the agreed price, no matter what it may actually cost him, and conversely the client agrees to pay the price whether the contractor enjoys an unusually large profit or suffers a huge loss. Another way to express it is to say that the contractor assumes the risk of all unforeseen costs, such as increases in labour and material costs, unanticipated subsurface soil conditions, adverse weather, and the like. Although the contractor carries the risks in lump sum contract, he also have an incentive to complete the works economically to make his profit. In the right circumstances this incentive can be very real. The minimum flexibility on the client can also impose a discipline on the accuracy and firmness of both design and specification, in the absence of which the client knows he will pay for the variations he has initiated.

The converse is true at the other extreme of a cost-reimbursable plus percentage fee contract. This contract imposes maximum flexibility on the client, in other words, the client does not have to specify exactly what he wants when he goes out to tender. On the other hand, there is no built-in strong incentive for the contractor to finish the job on schedule and to the lowest cost, as there is in lump sum contracts. Therefore the risk is now with the client and to protect himself from costs running away he must monitor and control costs and progress day by day to an extent which he need not do with a lump sum contract. This intervention may lead to disputes and claims for extras.

Based on discussions and findings, following sub-hypotheses are formulated as part of hypothesis H1, that risk perception by contractors is affected by some factors.

H1e: Civil engineering works will be perceived as involving higher risk than building works.

H1f: Using a non-standard contract will be perceived as involving higher risk than those with a standard contract.

H1g: Using a price-based contract will be perceived as involving higher risk than those with a cost-based contract.

3.7. A NEW PROCUREMENT SYSTEM IN CONSTRUCTION

The greater technical content, higher capital cost and desire for shorter schedules has led to the recognition of the shortcomings of the division between design and construction. Clients have also come to realise that for certain projects they can no longer manage their projects using only their own resources. Therefore, as the industry has become more competitive and projects more complicated, the traditional approaches of clients using general contractors have been modified.

The new concept centres around a grouping together of organisations offering the following disciplines (Moxley, 1993):

* Architecture
* Structural and services consultancy
* Building construction
* Services engineering and construction
* Cost consultancy

Management contractual organisations are generally formed to provide one of two types of services. The first is that of management contracting; the other is construction management (Pilcher, 1992). However, procurement procedures remain a dynamic activity. They will continue to evolve to meet the changing and challenging needs of society and the circumstances under which the industry will find itself working (Ashworth, 1994).

3.7.1. Management Contracting

For management contracting a client has a contractual relationship with a contractor who acts as a management contractor. It is normal practice for the management contractor to be precluded from undertaking any of the construction and to provide purely management services. A client also contracts directly with consultants to provide design and cost consultancy services. The management contractor then contracts directly with other contractors to carry out the construction work.

Management contracting has actually been in use for a considerable time, although it is only since 1987 that the Joint Contracts Tribunal has issued its Standard Form of Management Contract MC 87 - known as JCT MC 87.

The characteristics of a management contract are that the client engages the management contractor to participate in the project at an early stage, contribute construction expertise to the design and manage the construction (CIRIA, 1984). Because of these requirements, it is normal for the management contractor to be an experienced builder or construction company, but this is not necessarily a prerequisite. The management contractor is not employed for the purposes of undertaking any of the works, but solely for managing the process. In effect, management contracting is a procurement method consisting of 100% subcontracting. Every item of building work is subcontracted to 'Works Contractors' (Murdoch and Hughes, 1992).

3.7.2. Risk in Management Contracting

As a form of procurement the management contract offers contractors the opportunity to become professionals, to dispense with their labourforce, plant and equipment, and reduces their operating cost. Furthermore, as befits this status as one of the consultants, the management contractor's risk in connection with the project is reduced to a level that is similar to that of the other design consultants. In effect, the contractual risk associated with the construction of the building is distributed entirely between the client and works contractors. This leaves the management contractor with very little contractual risk. The risk that has been removed from the management contractor now has been transferred to the client. If a client decides to use a management contractor it has to be accepted that the pattern of risk sharing will be changed and can well leave the client exposed to more risk (Elton, 1985).

As suggested in Sub-sections 2.8.4. and 3.6.5., one of the fundamental principles underlying the apportionment of risk should be that, where a risk is transferred from one party to another, a financial adjustment must be made to balance it.

In the early days of management contracting, the intention was indeed to create a 'no-risk' contract for the contractor (Murdoch and Hughes, 1992). This was seen as the best way to encourage the contractor to act as professional consultant. However, as management contracting increased in popularity, some clients sought to draft contracts in such a way as to shift many of the risks back to the management contractor. The main risks involved in this way were risks associated with responsibility for works contractors, time overruns, defects maintenance, preliminaries and design. This shifting of the burden of risk led, in turn, to one of two results: either the management contractor would absorb the risk and put up the price, whereupon relations between the management contractor and the client became strained as they tended towards the adversarial; or the management contractor would let the works contractors under more onerous conditions, thus passing the risks down to subcontractors who were less able to bear them.

What must always be remembered is that management contracting does not aim to be an automatic solution to the problems inherent in procuring building. It will not by itself alter awkward people, nor re-orientate contractors who are habitual claimers. The client needs to be even more careful than usual in selecting personnel to appoint to the project team. And, of course, this team includes the management contractor.

3.7.3. Construction Management

For construction management a client enters into direct contracts with a professional construction manager (commonly designated as CM), design and cost consultants, and works contractors. The contractor undertaking the work is then in a direct contractual relationship with the client rather than with the construction manager. A main construction manager is appointed early to act as the client's adviser to provide planning, management and coordination of construction (Harris and McCaffer, 1989). The construction manager will undertake such management functions as are delegated directly by the client. This is a contractual arrangement that develops a team approach to building. The objective of this approach is to treat project planning, design, and construction as integrated tasks within a construction system.

The single most important distinguishing feature of construction management, and the one which distinguishes it most clearly from management contracting, is that the client places a direct contract with each of the specialist and works contractors. In order for construction management to work properly, the client must take an active role in the management of the process. It is desirable that the client has some experience of having worked with the construction manager, and some of the other consultants, on previous occasions.

Construction management has its origins in the USA. There the need for large buildings to be erected quickly and reliably, coupled with increasing technical complexity, led to the involvement of an ever higher number of technical people in the design, programming and construction of a building. The management of these people became less of an architectural issue, and more of a management issue. Unfortunately, it was clear that the construction professions in the UK found it very difficult to give complete acceptance to the management contract (Murdoch and Hughes, 1992). The British construction professions have their roots in systems of authority which date back to the middle of the last century. Because these professional traditions are so well established, it is difficult to form a team of people who have not worked together in the past and then to expect them readily to modify their traditional roles.

Since there is no standard contract for construction management, the contractual characteristics tend to vary from one project to another. However the central feature of a construction management project is that the client contracts directly with the works contractors who are doing the work, and the construction manager of the construction work has no contractual responsibility for their performance. If the construction manager does have contractual liability for the performance of the work contractor, then the arrangement is not really construction management at all, and will probably be found to be some form of management contracting.

3.7.4. Allocation of Risk in Construction Management

The risks in construction management contracts are substantially the same as those in management contracts, due to the similarity of the occasions upon which they should be used. However, subtle differences are found in the way in which these risks are commonly apportioned.

Time

The obligations as to time are entirely related to the construction manager's programme. This means that a client who wants speedy progress should appoint a construction manager who has proven experience of being able to complete projects quickly. However, too ambitious a programme will result in inflated tenders from the works contractors.

The risk of delay lies with a defaulting works contractor. However, the extent to which that contractor can actually be penalised depends on its financial resources. A small works contractor could incur claims for delay which amount to far more than its annual turnover, and could become insolvent. This is why works contractors may be required to have sureties and guarantors. Without these, the risks to the client could be enormous.

Money

The direct contract between the client and the works contractor, without the intervention of such administrative mechanisms as are found in general contracting, means that payment of certificates should be prompt. This should improve performance and minimise costs of finance to the works contractor. So, it is in the client's interest to help the contractor to keep costs down.

Quality

The extent to which the client is protected from having to accept inferior work depends on the adequacy of the architect's description and specification of the work to be carried out. The contractor is obliged to ensure that all work conforms to the descriptions in the contract documents, and that the relevant testing and inspection have been carried out. It would be difficult to think of any more thorough way of making the contract assure the client of the quality of workmanship and materials.

3.8. CONCLUSION

This chapter presented the main features of the construction industry as background to the study. The importance of the industry to the economy and the activities of the people or organisations that participate in the industry, the nature of 'construction products' and the types of construction contract have been established.

In terms of the products, most features originate from the dominant position of land as a product attribute. The present division of design and construction for efficiency is causing concern both among construction authors and practitioners. This should not be allowed to affect the satisfaction or the interest both of the client and contractor.

Since construction involves many type of participants in a great variety of interactions and contractual relationships its complex nature makes it a risky industry. So it is pertinent to stress the interrelationship between the decision and the type of construction contract used. The choice of contract can be regarded a risk management mechanism.

However, the review of construction industry and construction contract shows that most studies considered the viewpoint of the client rather than that of the contractor. Contractors in construction can also be in danger of risk in the contract making process, and this can be managed by applying appropriate risk management strategies.

CHAPTER FOUR: BUYING DECISION AND THE RELEVANCE TO THE CONSTRUCTION CONTRACT

4.1. INTRODUCTION

The previous chapter described some of the features of the construction industry and developed an overall perspective on the construction industry essential for a discussion of effective risk management strategies. That view is extended in this chapter which introduces a general model of the buying decision process in industrial markets and considers the relevance of this model to buying decisions in the construction industry.

Buying in the construction industry evolves through phases, each with its own inherent risks; and in general, a standard construction contract evolves through phases similar to that seen in a typical new-buy decision process for any industrial product. This suggests that risk in construction contracts is spread over the buying phases. Construction companies then need to analyse these buying stages to identify risk areas in the process, and thus the most appropriate risk management strategies that could be applied. Since contractors are intermediaries in the construction industry, not only selling their products but also purchasing building materials and services, a brief discussion of supply chain management is also included in this chapter.

4.2. THE NATURE OF ORGANISATIONAL BUYING BEHAVIOUR

All formal organisations, such as governmental agencies, business firms, educational institutions, hospitals, and religious and political organisations must purchase goods and services used in the conduct of their affairs. Buying is a complex process, not an impetuous act. Buying involves the detérmination of the need to purchase products or services, communications among those members of the organisation who are involved in the purchase or use of the product or service, information-seeking activities, and the working out of necessary arrangements with supplying organisations. Webster and Wind (1972:1) has pointed out that -

> "Organisational buying is a complex process of decision making and communication, which takes place over time, involving several organisational members and relationships with other firms and institutions."

Webster and Wind (1972:2) then defined organisational buying behaviour as:

> "The decision-making process by which formal organisations establish the need for purchased products and services, and identify, evaluate, and choose among alternative brands and suppliers."

4.3. THE ORGANISATIONAL BUYING CENTRE

Buying decisions, as Webster (1979) pointed out, represent a complex set of activities engaged in by many members of the buying organisation. Organisational buying decisions are made more complex by the fact that more people usually are involved in them and different people are likely to play different buying roles. The roles of 'users', 'influencers', 'deciders', and 'buyers' can be identified in most purchasing situations, and there are likely to be many people occupying each role, for example, several influencers, decision-makers, users, etc. The members of the organisation involved in the buying decision are referred to as the decision-making unit (DMU), or the buying centre (Parkinson and Baker, 1986). A considerable amount of attention has been given to the composition of the DMU in industrial marketing, as there are obvious benefits in determining who is involved in or influences the buying decision. One study was conducted by Buckner (1967) who found that buying decisions in British industry showed variations in the involvement of different specialists in different industries, and inside the same company when purchasing different products.

Involvement of different members of the organisation varies by stage in the buying process, as well as by type of purchasing situation, as Brand (1972) has shown. He found that the greatest involvement of different functions occurred with purchases that the company had not made before. The least wide involvement occurred with purchases which were straightforward repeat buying situations.

Hill and Hillier (1977) developed an analogy between the buying centre and the structure of an atom. In their view, the decision-making unit that is the primary target for marketing corresponds to the atom's nucleus. Other members of the organisation able to influence the decision, such as senior management, are seen as forming a shell around the decision unit. They influence its behaviour and constrain its actions. A further shell of influence is created by other members of the organisation and management in other organisations, who provide information on which decisions are based. The authors continue their analogy by suggesting that where the company is buying something it has bought regularly in the past with well known performance characteristics, then there will be comparatively little activity outside the nucleus. In a new purchase situation the amount of activity will be considerably greater, with individual components becoming increasingly active.

Cardozo (1980) has suggested that the involvement of different managers in the decision process depends upon the type of product, the buying situation, the importance of the purchase to the organisation, and the degree of uncertainty in the purchase. These factors can be combined to describe different buying situations as a basis for segmenting the industrial market. Where a product is identified as low risk, with few or limited consequences if it proves unsuitable, then the buying centre will be limited to a few managers involved essentially in procedural decisions. In contrast, when the product is perceived as high risk with considerable consequences if it is unsuitable, then greater involvement of different managers in the buying centre is likely, and the decision itself is likely to take considerably longer.

Webster and Wind (1972) suggested that a decision-making unit is made up of one or more managers with the following roles:

* Users: Users of the purchased item such as the Production Department.
* Influencers: Members of the organisation who influence the purchasing decision, even though they may not be centrally involved in it.
* Buyers: Those members of the organisation who have the authority to select suppliers and arrange the terms of purchase.
* Deciders: Those members of the organisation with formal or informal power to determine the final choice of supplier.
* Gatekeepers: The individuals who control the flow of information into the organisation, and in doing so indirectly influence the purchasing decision.

All of these roles could be played by one member of the organisation. Alternatively there may be several members of the organisation in different roles, or one member filling several roles in a larger group.

Johnson and Bonoma (1981) studied the patterns of interaction between the members of the buying centre.

They adopted a structural and interaction based systems concept to examine the functions of the corporate buying centre from a small group perspective. The authors classified the different patterns of interaction and influence between the members of the buying centre and distinguished five different dimensions for analysis. These were: the involvement of managers from different levels in the organisation in the buying decision, the degree of lateral involvement of managers from different functions, the total number of people involved in the process, and the number of linkages between them, and the centrality of the purchasing department in the process.

We have reviewed several studies on the composition of the buying centre (Parkinson and Baker, 1986; Johnson and Bonoma, 1981; Webster, 1979; Hill and Hillier, 1977; Webster and Wind, 1972). An understanding of interpersonal relationships in the buying centre is an important basis for the understanding of the buying decision processes and activities and will be discussed in the following section.

4.4. THE ORGANISATIONAL BUYING DECISION PROCESS

The organisational decision-making process at the core of organisational purchasing is a complex process that takes place over time and involves several members of the organisation, and its relationships with other organisations. Buying decisions, as Webster (1979:27) has pointed out, do not just happen.

> "They represent a complex set of activities engaged in by many members of the buying organisation and result in a commitment to purchase goods and services .... Buying is not an event. It is an organisational decision-making process, the result of which is a contractual obligation."

As an organisational process, buying decisions in the industrial market evolve through stages on a continuum. There are many different views of the sequence of the various stages comprising the buying decisions demonstrated by various studies and models of organisational buying behaviour.

4.4.1. Buying Decision as a Sequential Process

One of the earliest comprehensive studies showing that buying decisions evolve through stages is presented in the model by Robinson, Faris and Wind (Robinson et al, 1967). This model is based on the findings of a two-year study in three different companies in the United States. The findings led the researchers to suggest that industrial buying decision process evolves through eight stages:

1) Problem (need) recognition
2) Determine characteristics
3) Describe characteristics
4) Search for source
5) Acquire proposals
6) Evaluate proposals
7) Select order routine
8) Performance feedback

The researchers also recognised that some of these stages could be jumped or combined, depending on the nature of the decision. Webster and Wind (1972) also demonstrated that a buying decision evolves through five procedural stages. These stages were defined as:

1) Identification of need
2) Establishing objectives and specifications
3) Identifying buying alternatives
4) Evaluating alternative buying actions

5) Selecting the supplier

Wind (1978) also found that buying decisions evolve through stages. Wind identified twelve stages for the purchase of scientific and technical information services. They are:

1) Identification of needs
2) Establish specifications
3) Search for alternatives
4) Establish contact
5) Set purchase and usage criteria
6) Evaluate alternative buying actions
7) Determine budget availability
8) Evaluate specific alternatives
9) Negotiate with suppliers
10) Buy
11) Use
12) Conduct post-purchase evaluation

Sheth (1973) also shows that a buying decision evolves through stages. His model's emphasis on the role of information in buying decision process also brings in the relationship between the concept of perceived risk and the search for and utilisation of information.

We have reviewed several buying models so far. These models vary in complexity from Webster and Wind's (1972) five stages, to Wind's (1978) twelve stages for the purchase of scientific and technical information services. This variation suggests that the buying process is complex, it may vary by product/industry and buying situation (straight rebuy, modified rebuy or new task), it is difficult to model, and most critical, it is difficult to validate empirically since the order in which these stages are presented to respondents can effect their own responses.

Although the buying process is likely to vary between different types of purchase, and also in different industries and organisations, the nature of the process of different models is reconciled. Generally speaking, the buying decision process starts with the recognition or the awareness that the organisation has a problem which can be solved through purchase. Consequently, the need for purchased goods and services will be defined with sufficient clarity to permit the drawing up of specifications for the purchase. When the specifications and schedules for the purchase have been defined, the responsibility is given to search for available alternatives, and to suggest the best way of solving the problem or satisfying the need. Eventually, a final buying decision can be made among various potential suppliers to meet the specifications. Obviously, such a complex process, involving several people each influenced by many factors, leading to a final contractual obligation, cannot be described as 'a point-decision', or a simple event.

Parkinson and Baker (1986) also regard the buying decision as 'a sequential process' in which certain criteria are applied to alternatives in order to arrive at a final choice. This is evident in their sequential process model. The model itself is expressed notationally as follows:

$$P = f\ [SP,\ (PC,\ EC,\ (T_A - T_D),\ (E_A - E_D),\ BR)]$$

where

P = purchase

f = a function (unspecified) of

SP = selective perception

PC = precipitating circumstances

EC = enabling conditions

T_A = technological advantages

T_D = technological disadvantages

E_A = economic advantages

E_D = economic disadvantages

BR = behavioural response

In this sequential model: PC is equivalent to awareness, EC to interest, (T_A-T_D) and (E_A-E_D) represent evaluation, and BR dictates the action taken, which, of course, is not always to purchase but may be to reject the proposition or to defer judgement. Naturally, the decision maker evaluates (T_A-T_D) and (E_A-E_D) involved as he moves from one buying decision phase to another. This enables him to identify the potential risks and so take appropriate action (BR).

There is no doubt from the research (Parkinson and Baker, 1986; Wind, 1978; Webster and Wind, 1972; Robinson et al, 1967) that buying decisions in the industrial market generally evolve through stages. This is especially the case in new-buy situations. The starting point in most cases is the recognition by the decision maker of a problem to be solved, or a need to be satisfied.

4.4.2. The Customer's Role in Buying Decision Process

The customer in the industrial market has a crucial position in the purchasing process. This is because, as the buying models demonstrate, it is the customer who in most cases determines:

* What they believe the problem is;
* How and when the problem should be solved;
* Who should participate in the solution of the problem; and
* Whether the solution thus provided has actually solved their problem satisfactorily.

In essence, it is these four conditions that provide the basis for the buying decision process. The nature of the buying process however depends on the type of the buying situation. We shall therefore consider buying situations in the industrial market, and show which ones are relevant to the construction industry.

4.5. BUYING SITUATIONS

Every buying situation can be characterised by three interrelated factors (Webster and Wind, 1972):

1) The newness of the problem and the extent that key decision-makers have relevant buying experience;
2) The amount and type of information requirements of members of the buying centre;
3) The number of new alternatives considered in the buying decision process.

Given these three criteria, buying situations can be classified into three main situations (Robinson et al, 1967):

1) New task
2) Straight rebuy
3) Modified rebuy

New task buying situations are those which have not arisen before and in which the buyer has little or no relevant past buying experience. In such situations a great deal of information is required and new alternatives must be considered to solve the problem. Straight rebuy situations are recurring buying situations which do not require any new information and are handled on a routine basis. In such situations there is often no motivation to consider new sources of supply. Modified rebuy situations are those which may develop from either new task or straight rebuy situations. The buying alternatives are known but they are changed (for example, a price change or any other change in any of the supplier's offerings) and buyers have some relevant buying experience although some additional information is needed and new sources of supply may be considered.

No matter what kind of buying situation is involved, it is generally accepted that the customers main aim in buying is to satisfy their needs. However, the problems presented by the differing situations are not the same. In most cases the risks presented by each of the buying situations differ considerably, and these differences lead to somewhat different decision-making processes. This also implies that the strategies for managing such risks in each situation would also be different.

Since each construction project tends to be more or less unique, it would seem that most buying decisions are for the new task or new-buy situation. Consequently, the new-buy situation will form the basis of the discussion in this chapter. However, while the emphasis still remains on the new-buy situation, both the straight rebuy and modified rebuy situations are also discussed here.

4.5.1. Straight Rebuy Situation

Basically, this refers to a situation where the purchase of an item is as a result of recurring requirement. Normally, most of the groundwork and required information must have previously been undertaken. The purchase is therefore based on the procedure which may have been established in the buying company to handle such routine decisions.

Straight rebuy decisions exemplify the application of the 'Learning Curve' concept, and are therefore similar to what Howard and Sheth (1969), and Howard (1977) described in their model as 'Routinised Response Behaviour'. Since straight rebuys are 'repeats' of a decision taken before, the decision maker is assumed to have taken all the necessary steps to manage any inherent or potential risks at the time the decision was first made. Consequently, those making a straight rebuy decision tend to perceive relatively low levels of risk in their decisions (Newall, 1977). The result is that 'source loyalty' tends to be a major characteristic of straight rebuy decisions.

Obviously, this cannot be described as a common feature of buying decision making in the construction industry, except where such decisions deal with supply of materials or other related items for a construction project. As far as the client is concerned therefore, the situation he faces when he is deciding to buy a construction product is quite different. Very often it is a new situation, much more complex, and cannot be described in any way as a straight rebuy situation.

4.5.2. Modified Rebuy Situation

A modified rebuy situation may be described as a 'Limited Problem Solving' in a buying decision making process (Howard, 1977). Unlike straight rebuy situation, the distinguishing characteristic of the modified rebuy situation is that the decision maker feels that some kind of benefits could be derived from a re-evaluation of alternatives. Therefore, as Robinson et al (1967) have observed, a variety of factors may lead to a modified rebuy situation. These factors include:

* a change in the buyer's need which may lead to changes in specifications of the item originally required;
* genuine efforts on the part of those concerned to improve a given end product;
* the buyer's effort to search for alternative sources that could lead to cost savings for him;
* the buyer's dissatisfaction with the supplier's performance.

Applied to the construction industry situation, the factors can be redefined in terms of the following:

* change of client's need or requirements;
* product performance;
* cost savings;
* contractor's performance.

However, the term 'modified rebuy', as it is used in industrial marketing, does not seem to have a recognised application in the construction industry as far as the buying situations facing the client are concerned. It may be observed that government agencies, hotel chains, and other organisations may commission a number of similar structures in different locations, which, to some extent, is a form of modified rebuy. Such cases, however are exceptions rather than the rule. Therefore, the buying situation that is of great relevance to the buying decision process in the construction industry is the new-buy situation.

4.5.3. New-buy Situation

The new-buy situation is a 'first time' purchase which results from a need that has not arisen before. This may be described as 'Extensive Problem Solving' in a buying decision making process (Howard, 1977). The customer in this case confronts a new problem and has little or no relevant experience to draw on. Consequently, the customer usually requires much information and comes to a decision slowly. Therefore, the buying decision making of the client in the construction may be described as a 'new-buy' situation.

New task or new-buy decisions present a complex situation where all stages of buying decision process are seen. Previous review discussed several models in new-buy decisions. Some authors (Webster and Wind, 1972) have suggested five procedural stages, while others (Wind, 1978; Parkinson and Baker, 1986) defined differently. The most widely used and acclaimed model is probably that of Robinson, Faris and Wind (Robinson et al, 1967). This model has shown convincing evidence that the buying decision in the industrial market evolves through a process divided into eight stages or phases. This model has been adopted by the author as a basis for considering the buying decision process in the construction industry.

4.6. COMPARISON TO THE CONSTRUCTION PROCESS

A study report of the Tavistock Institute (Tavistock, 1966:12) defined a Building Process as -

> "The whole series of activities required between the initiating point of a client's need and the production of a building to fulfil that need."

The construction process is long, involved and often cumbersome, its success depends on having the right relationships between all parties in the process. There is a great range of possible methods of organising the process each with different contractual relationships and procedures. An important question that arises is whether these construction processes have an impact on the buying decision processes. Fellows et al (1991:3) have said:

> "The components of every commercial transaction are a customer who wants a product, the product itself and a firm which designs, makes and/or sells the product. The construction industry is no exception. The principal components in any construction situation are the client, the project, and the firm."

In *How Flexible Is Construction*, NEDO (1978) identified the following stages for new building and civil engineering works:

* Conceptual
* Design
* Contract documentation
* Construction on site

It listed the main activities of each stage as being:

* Conceptual
  - Conception of demand
  - Outline proposals
  - Finance source identification
  - Site acquisition
  - Design brief
* Design
  - Scheme design
  - Detail design
  - Detailed planning
  - Confirmation of finance
* Contract documentation
  - Contract documentation
  - Preparation of tender
  - Letting main contract
* Construction on site
  - Contract administration and site supervision
  - Input of manpower
  - Input of materials and components
  - Plant utilisation
  - Construction

RIBA's *Architect's Appointment* (RIBA, 1982) identified more stages in a construction project:

* Inception
* Feasibility studies
* Outline proposals
* Scheme design
* Detail design
* Production information
* Bills of quantities
* Tender action
* Preparation of the contract
* Operations on site
* Practical completion
* Feed-back

Whittaker (1971) also described the stages in a buying-decision process of a building project as:

* Client
* Sponsor
* Brief
* Design
* Bill of quantities
* Selection of contractor
* Construction

Obviously, the buying decision process of a construction project as illustrated by Whittaker above, does not cover 'the whole series of activities required' in a building construction process. Rather, it represents only a rough description of the traditional process.

Regardless of the framework used it shows that the client, having determined that they need a building, contacts the sponsor. The sponsor could be an organisation, an architect, a contractor, or any person connected with the construction industry. Together with the client, the sponsor draws up a brief of the client's needs or requirements. The brief itself may be anything from a mere discussion between the client and the sponsor during which the sponsor identifies unrecorded ideas through to a detailed written description of the required building. After the brief is completed, the client appoints the main designer who becomes their chief adviser. The main designer advises the client on the specialists, such as the soil engineers, services engineers, architects, and structural engineers, and becomes the leader of the design team. The design team will then carry out the detailed design work. After the detailed design is finished, the client appoints the quantity surveyor responsible for cost advice, for drawing up contract documents, and for preparing the bill of quantities. The designer, and often the quantity surveyor, advises on the selection and appointment of the main contractor. The main contractor with subcontractors then constructs the required facility in accordance with the contract specifications.

This brief description of the buying and construction process confirms with the traditional construction process presented in *How Flexible Is Construction* (NEDO, 1978), and the *Architect's Appointment* (RIBA, 1982).

A comparision of buying decision stages in the industrial market and those in the construction industry, is shown in Table 4.1. The buying decision stages in the industrial market have equivalents in the construction industry.

The comparision of the buying process appears simple, straightforward, and formalised but the construction industry's 'formalised system' (Tavistock, 1966) only represents how the construction process should function, for example, getting work, doing work, getting paid and administering these activities have to be performed; not how it actually does.

There is also no doubt that a careful examination of the buying stages show that their evolution during a construction project is fraught with risk to both the seller and the buyer. Problems encountered on construction sites, wrong estimates, and changes in specifications by clients all introduce serious risks that cannot be ignored. The risk implications of these buying stages can then be identified.

Table 4.1. Comparison of the Buying Decision Stages

Industrial Product	Construction Product
Anticipation or recognition of the problem or need	Anticipation or recognition of the problem or need
Determination of the characteristics and quantity of the needed item	Scheme design and cost estimate
Description of the characteristics and quantity of the needed item	Detail design, planning and budgeting
Search for and qualification of potential sources	Prequalification stage
Acquisition of proposals	Tendering stage
Evaluation of proposals and selection of sources	Evaluation of bids and selection of contractor
Selection of an order routine	Commitment stage
Performance feedback and evaluation	Performance feedback and evaluation

4.7. THE LINKAGE OF THE SUPPLY CHAIN MANAGEMENT

The discussions so far have followed the point of view that a client is a buyer and a construction firm is a seller in the normal business transaction of a construction product. That product may, for example, be a building, or a bridge, or a motorway.

However, production of construction products needs materials inputs as contractors are intermediaries in the construction industry, not only selling their products but also purchasing building materials. The supply chain is the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer (Christopher, 1992). Macbeth and Ferguson (1994) stress that the quality of any process downstream is dependent upon the quality of the process upstream. In other words, the quality of the project built by the contractor is directly related to the quality of the materials, equipment and services supplied by the vendors, and the quality of the work performed by the subcontractors.

Building materials may be described under one of three headings: materials, components, and goods (Ashworth, 1991). Materials are the raw materials to be used for building purposes and include cement, bricks, timber, plaster, etc. The components represent those items delivered to site in almost 'kit' form. They may include joinery items such as door sets or joinery fittings to be assembled on site. The third category described as goods, includes those items that are generally of a standard nature which can be purchased directly from a catalogue - for example, sanitary ware, ironmongery, electrical fittings, etc.

In the construction industry the chief problems have been the acute basic materials shortages, caused by economic and international problems which have resulted in fluctuations in cost and supply (Calvert et al, 1995). Since the materials and components content of a contractor's cost generally exceed 50 per cent or more, and the contractor's source of supply for these items varies, close and long-term relationships with the suppliers to the construction process are required if the contractor is to achieve the best economy and quality. Therefore, the relationship between the contractor (buyer) and supplier (seller) becomes an important management issue.

4.7.1. The Long-Term Buyer-Seller Relationship

Deming (1986) stresses that companies should end the practice of awarding business on the basis of a price tag alone. Traditionally, in the construction industry, contractors, subcontractors, and suppliers are all pitted against one another to compete on the basis of low bid contracts. Based upon competition as the key to good buying, there can arise a number of disadvantages as a consequence. It can take time for both buyer and seller organisations to familiarise themselves with the details of each other's methods and requirements at the beginning of the contract period. Sellers have no real incentive to improve performance during the operation of contracts and, indeed, may let it deteriorate towards the end, if there is perceived to be a strong probability of not retaining the business (Saunders, 1994). Also the relationship between buyer and seller has been seen as an arm's length relationship. It was necessary to keep at a distance, neither becoming too dependent upon a supplier nor allowing a supplier to become too dependent upon any one customer. It was even possible to suggest that it was unethical to get too close to a supplier (Syson, 1992).

This view led to multiple sourcing as the norm; sole sourcing effectively placed too much power in the hands of the supplier. Allied to this concept of choice as a vital feature of the purchase portfolio is that of periodic re-tendering. A consequence of annual contracts is that the supplier must legislate for the contingency that he could lose any particular contract. Hence each contract needs to be financially profitable on a stand alone basis and this might be in spite of excellent quality and service. This becomes a main risk that buyer may face in dealing with suppliers.

Inherent in the concept of managing the supply chain, is the notion that there should exist mutual dependence between supplier and buyer. This is totally at variance with the traditional approach. In the mainstream activity, the survival of each party is perceived as being dependent on the other. Suppliers support their customers even at the cost of short term difficulties for themselves. Benefits in terms of profitability or of quality improvement are there to be shared. This is therefore the notion of partnership based upon a perception of mutual advantage. Interest in partnerships is based upon a long-term perspective of buyer-supplier relationships. This is in contrast with traditional purchasing practices which emphasised the short-term, transactional or clerical nature of purchasing work.

The idea of working closely with suppliers is not new. This idea now appears in English as 'partnership sourcing' (Macbeth and Ferguson, 1994; Baily et al, 1994; Saunders, 1994). A definition of a partnership is provided by Partnership Sourcing Ltd (1992:4) as:

> "Partnership sourcing is a commitment by both customers and suppliers, regardless of size, to a long-term relationship based on clear, mutually-agreed objectives to strive for world-class capability and competitiveness."

A number of influential business concerns in Britain have adopted the principles of partnership sourcing, and report considerable benefits. For example, Laing Homes, part of the Laing Construction Group have achieved great success. Instead of keeping information about programmes close to their chest, Laing Homes share information on where business is developing, allowing suppliers to plan production and in turn to help their own materials suppliers. Laing also report that at one time much of the timber used on construction sites arrived in random lengths of variable quality. As a result of an improvement project involving their supplier timber is now supplied to length, and of a consistent quality.

This also improves the schedule performance. This results in lower overall costs and risks.

In a new relationship between buyers and suppliers there is a changed nature to do with openness, sharing of information, increased trust and dependence. A failure in any part of the supply chain, which causes the final customer to be dissatisfied, intimately affects everyone in that chain (Macbeth et al, 1990). Both parties must invest resources in meeting the specific needs of the partnership as a concrete demonstration of their commitment.

The real competition in the future is not company against company but rather supply chain against supply chain (Christopher, 1992). Successful projects will be decided on the basis of quality (life-time cost of the product and not the initial cost) and supplier responsiveness, which can only be achieved through partnership relationships (Macbeth and Ferguson, 1994). These relationships will involve fewer suppliers and they will be based on mutual trust. However, there are dangers in sole or dual sourcing of which the possibility of discontinuities in supply is the most serious. The benefits of a partnership relationships are typically found to be:

* Shorter delivery lead-times
* Reliable delivery promises
* Less schedule disruption
* Lower stock levels
* Faster implementation of design changes
* Fewer quality problems
* Stable, competitive prices
* Orders given higher priority

One specific risk about contractor-supplier relationship is worth mentioning here. In an industry with low capitalisation such as construction, the bargaining power of suppliers (and subcontractors) is considerable. Since construction is essentially a large industry of small firms, many builders merchants are far larger than the building firms they supply, and the withdrawal of credit has often brought bankruptcy to building contractors. To mitigate this potential risk a number of larger contractors have adopted backward integration, purchasing materials suppliers and plant hire companies.

4.7.2. Risk Allocation in Subcontracting

A contract of some type will normally be the result of competitive bidding or negotiations with suppliers or subcontractors, and there are many types of contract. The type and its complexity will depend on the nature of the purchase, length of the agreement, negotiations, etc. Clearly, a contract sets the legal basis for the buyer-seller relationship, so it is important for a contractor to choose the right kind of contract reflecting the amount of commitment he is making and that which he expect from his supplier.

Standard contracts with standard terms and conditions have been agreed in construction and civil engineering industries, and use of these standard contracts is strongly recommended by the Department of Trade and Industry (DTI, 1991). They have usually been agreed between the supplier's trade association and the buying industry's association. A simple classification of subcontracts is by reference to the kind of work which they involve. A pure supply or 'materials only' contract, assuming that no hire purchase or similar arrangement is involved, will be subject to the *Sale of Goods Act 1979*. A 'labour only' contract will fall instead under Part II (the 'services' provisions) of the *Supply of Goods and Services Act 1982*. As for contracts which contain both elements, these are again caught by the 1982 Act - the transfer of materials is subject to Part I and the provision of services to Part II.

A more significant way of classifying subcontracts is by reference to the question of whether the subcontractor is selected by the main contractor or the client. A 'domestic' subcontractor is one in whose selection and appointment the client plays no part, other than simply giving consent. In theory at least, the appointment of the subcontractor is entirely for the benefit of the main contractor, a purely 'domestic' matter. As to the terms of domestic subcontracts themselves, there is no doubt that these are far less 'standardised' than those of main contracts. Many subcontractors, especially those who simply supply materials, have their own 'standard form' of subcontract, as do many main contractors. However, there have been complaints that the latter are often harsh and onerous.

Nomination is the practice by which a client, through his chief consultant, selects persons who then enter into subcontracts with the main contractor. This procedure is found mainly in the UK. Murdoch and Hughes (1992) maintain that nomination has developed in order to give the client control over the quality of subcontract work, but it also has an important bearing on time and price.

On any construction project in which subcontractors are involved, the possibility of default by a subcontractor is an inherent risk. The allocation of that risk, as between the client and the main contractor, is a matter for the main contract. Naturally, the immediate effect is that the subcontractor is liable to the main contractor - the other party to that contract - for breach of contract. About this not very much needs to be said. The issue which must be discussed is the extent to which the client can hold the main contractor responsible for the subcontractor or supplier's defaults.

Domestic subcontractors

In theory, the appointment of a domestic subcontractor is entirely for the main contractor's benefit. Therefore, as a general rule, any risks involved in such a subcontracting are to be borne by that main contractor. The contractual duty of performance rests entirely on the main contractor, and if this is broken by the actions of a chosen subcontractor, either in breaching the contract or in dropping out altogether, there can be no excuse. For example, where a contractor who installed an up-and-over garage door for a client selected a lintel from a supplier's brochure, and this proved to be defective, the contractor was held liable. The contractor's duty to the client was to supply suitable materials, not merely to exercise reasonable care in selecting them.

Nominated subcontractors

A main contractor's responsibility for a nominated subcontractor's work is most likely to arise in respect of failure to comply with required standards of workmanship, or the quality and fitness for their purpose of any materials supplied. If materials are defective, the general principle under the *JCT Standard Form of Building Contract* is that the contractor is in breach. This will involve liability to the client for any loss such as the cost of replacement. However, it should be noted that, apart from any express terms in a building contract, it is the contractors implied obligation to build in a workmanlike manner with materials which are of good quality and fit for their intended purpose. While the obligation as to the fitness of materials only arises where the client has relied on the 'skill and judgement' of the contractor, and will therefore be exclude where a subcontractor is nominated.

A particularly controversial area of risk allocation in respect of nominated subcontractors and suppliers is that of delay. JCT 80 has treated this as an area where the client should bear responsibility for those who have been chosen, by providing for the main contractor to be granted an extension of time. Where such an extension of time is granted, the client is deprived of the right to claim liquidated damages. As a result, unless the client can make a direct claim against the subcontractor under a collateral warranty agreement, the main incentive for the subcontractor to keep to time will simply disappear.

The question: 'who is responsible for a nominated subcontractor?' is not one to which a simple or straightforward answer can be given. It depends upon the type of default which is in issue, the kind of loss caused, the person who suffers the loss, the subsequent actions of the parties and, most important, the precise terms of the contract.

4.8. CRITICAL STAGES IN BUYING DECISION PROCESS

Although the eight stages scheme suggested by Robinson et al (1967) is the most widely accepted, it has been shown that the process will vary depending on the nature of the decision. These buying stages are also relevant to the buying process in construction.

Having considered the various stages, and particularly, the activities which occur in each, it is possible to identify critical points in the process. There is some evidence that certain decision stages are of critical importance to both the buyer and the seller. These stages have been referred to by various authors as 'key decision points' (Webster, 1979) or as 'focal points' (Hill and Hillier, 1977) in buying activity, or what Robinson et al (1967) has described as 'a centre of gravity'.

The basic concept is that a particular stage or a combination of stages in the buying process could become the centre of gravity or a pivot upon which all other activities will depend. It is generally agreed that the phase that becomes critical depends on the type of the buying situation. In the construction industry four key decision areas have been identified as most likely to be critical. These stages are -

1) The precipitation stage
2) The product design/specification stage
3) The contractor selection stage (which combines bidding and/or negotiation)
4) The commitment stage (which combines contracting and the execution of contract)

With this background in mind, we can look at the buying phases as they apply to a construction contract.

4.8.1. Precipitation Stage

A buying situation is created when someone in the organisation perceives a problem that can be solved through the purchase of a product or service. In general, the process of buying in the construction industry is 'triggered' by the client recognising that they have a problem which can be solved by purchasing a construction product.

In some cases however, the buying process can also be set in motion by a potential seller, who may recognise that the buyer's need for a particular product or service. This enables the seller to convince the customer that such need can be satisfied through the purchase of a particular item. Contractors may anticipate, precipitate a need, or recognise that a need for a construction product exists in the buying organisation to their own benefit. This proactive approach has an positive effects on all the subsequent stages of the process. The overall advantage to the contractor is such approaches may enable him to understand better not only the nature of the client's need but also the nature of the risks involved. This should allow more effective planning and more effective strategies to manage potential risks.

4.8.2. Design Stage

To speak of design, it is first necessary to agree on a definition. Here, the definition suggested by Stevens (1979:49) is adopted. It is to have a broader interpretation, that is:

> "The total of the activities of the designers for a project in construction."

Seeley (1983) emphasised it is at the design stage that final decisions are made on all matters relating to design, specification, construction and cost. NEDO (1976) indicated that the design function is concerned with establishing the client's requirements, preparing a detailed design brief, designing alternative schemes to meet the client's requirements, and producing the necessary information to enable the selected design to be constructed. It involves defining the need, creating ideas, making choices and closing options, by evaluation and discussion between all concerned. Obviously, design is not concerned with contriving a scheme only.

The design stage includes Scheme Design and Detail Design these two stages shown in Table 4.1., and combines stages (2) and (3) from the buying model of Robinson et al (1967). Design stage is one of the most critical buying decision phases. It is in this phase that the characteristics and quantity of the required item are determined, described, or specified, and translated into a document which forms the guidelines upon which further actions by all those concerned must be based. Thus, the design or specification stage may influence not only the nature of the required item, but also the entire process.

However, even the best designed work (and too often projects are awarded and begun with insufficient design) must be adapted to the site conditions which are only discovered slowly, thus requiring a constant refinement of construction design (Bertinelli, 1985).

Risk Implications

The importance of the design/specification stage reflects the impact that a design errors or mis-specifications may have on performance risk and variations risk. These risks affect both the client and the contractor, though the specific effect on each of them may be different. These risks will now be treated in greater detail.

Performance Risk

The main aim of the client in buying a construction product is to satisfy a particular need or solve a particular problem. However, the client stands the risk of not achieving this objective if the specifications are inadequate or the design is wrong or faulty. Performance risk therefore, is one risk which the client may face.

In the construction industry this may be important since in most cases, 'design is divorced from production', and the client may not be able to blame the contractor for conditions which the client has created. On the other hand, it may be that some specifications required may not be essential after all. These non-essential attributes may increase the cost of the product. The client may risk paying for product attibutes not needed. These unnecessary costs can be best eliminated by using value engineering/analysis to provide a careful analysis of the specifications and design, and the actual function required (Harper, 1978).

What affects the client is also likely to affect the contractor. The contractor may be affected by the following risks in the following ways.

The first type of performance risk arises from the the contractor's performance. This risk is usually covered by a performance bond. The performance bond is an assurance by a bank, insurance company or other acceptable guarantor undertakes to pay a specified sum if the contractor fails to discharge his obligations satisfactorily (Seeley, 1986).

The second type of performance risk arises from the performance of the product for a specified period after it has been completed. This type of risk is normally covered by retention moneys or clauses (Maher, 1982). Most construction contracts have a retention clause, which allows the client to retain a part of the payments due for a specified period after the product is completed and its performance found satisfactory. The period commonly accepted in construction is twelve months (Marsh, 1981). Although this money normally is paid at the expiry of the retention period, this may not be so where the performance or the product is found unsatisfactory.

Variations Risk

Before considering variations risk, it is useful to understand the meaning of 'variation' as it has been defined in a traditional competitive contract - JCT 80 (The Joint Council Tribunal Standard Form 1980). The term 'variation' as used in the construction contract means (The Aqua Group, 1986a:38):

"The alteration or modification of the design, quality or quantity of the works as shown upon the contract drawings and described by or referred to in the contract bills."

A 'variation' is an authorised change in the scope of the work, the cost of which is not included in the contract price (Cahill, 1990). Variations may be described as the 'cancer' of contracting. Their cumulative effect can destroy the best contracts: the habit of ordering them is a disease (Marsh, 1981). However, some variations are inevitable. An original specification can be inadequate, or there may be design errors.

Design variations can be a serious impediment to the timely completion of work and can be very expensive. They are a cause of protracted disputes between clients and contractors, wasting scarce design skills (NEDO, 1970). The risks which the client may face as a result of variations could be serious and depend on:

* It will depend on the stage in the development of the product itself. For instance, the risk may be greater where the variations occur when the product is about to be completed, especially if this is a major variation.
* It will depend on the nature of the variation. For instance, variations which involve the foundation, and which require a building to be demolished before such variations can be effected, could be very expensive indeed.

Thus, the client needs to analyse their designs and specifications to ensure they represent real needs before committing to their actual production. On the other hand, the specific risk which variations present depends on:

* Who is responsible for the variations. For instance, variations caused solely by the contractor will likely force him to bear the responsibility for them.
* The contract's wording, indicating in clear terms what shall be done in event of variations.

In gereral, the main risk of variations arises from the possibility of creating delays. If delays occur it is the client who may bear the major effect of late delivery, especially if the product is to be used for commercial purposes. Where the effect on the contractor is limited a delay on the project, it may not benefit him especially if the marginal gains of extention are not sufficient to compensate for the costs of resources occupied which may have made more gains elsewhere. Variations therefore, constitute a risk both to the client and the contractor.

4.8.3. Pre-qualification Stage

Selective tendering, based on pre-qualification or approved lists, is strongly recommended in an ICE (Institution of Civil Engineers) document (ICE, 1983) as being the best procedure to select and appoint a contractor, affording maximum efficiency and economic advantage. It offers a popular and relatively straightforward procedure ensuring meaningful tenders with the least delay (Seeley, 1986). With selective tendering, pre-qualification of contractors is normally needed to compile a list of firms qualified to receive invitations to tender. Contractors invited to pre-qualify are asked to submit details of their relevant experience for specific project under consideration. The information required should reflect the technical content and scope of the work proposed. The factors to be considered can be categorised under following three broad heads (Seeley, 1986):

1) The contractor's financial standing. It is important to know whether the firm is financially stable and has the guaranteed backing of a larger group to manage any possible financial problems that may occur.
2) Technical and organisational ability. It is necessary to establish whether the firm has adequate capacity and ability and a satisfactory management structure to undertake the work at the appropriate time.
3) General experience and performance record. The client and his architect will wish to determine whether the firm has had sufficient experience in the particular type and size of project to be undertaken, and a satisfactory performance record.

The extent to which contractors should be asked to pre-qualify will depend on the nature of the work and the information already available to the client. Contractors whose qualifications and past performance records are already well known should not be required to pre-qualify. On the basis of the information supplied, a list of those suitable or qualified for the work can be compiled.

Most construction clients keep a list of approved contractors who have been pre-qualified after a screening exercise. This list becomes the main source of information about contractors when an invitation for bids for a contract is to be sent out. The list itself may be revised from time to time to include contractors and drop others in the light of the client's experience.

Risk Implications

The principle aim of maintaining lists of approved contractors is to identify firms with the necessary technical and financial resources to complete the contract satisfactorily. Although the pre-qualification process offers the client the advantage of an information bank, it also involves some risks for both the client and contractor.

The client may become too attached to the list of pre-qualified contractors, and lose the benefit of more efficient construction companies. Furthermore, it is possible that the firms on the list may know of each other and then collude to the disadvantage of the client. As Mitchell (1977) has pointed out, in any real-life bidding situation, there are many complicating factors, not least the possibility of collusion. Sheldon (1982) has examined collusion in detail. In view of the uncertainty of competitive bidding and the degree of interdependence between firms, Sheldon holds that bidding may be conducted *a priori* through collusive agreements. Such agreements would be an attractive means of maintaining a steady flow of work and achieving higher joint, risk-adjusted discounted profits.

Collusion has not been found to be a common practice in the British construction industry. Collusion, if practised at all in the construction industry, must be restricted to a limited number of specialised projects (Skitmore, 1989). In Taiwan, however the recent Control Yuan Enquiry (The Control Yuan, the highest supervisory organ of the nation, with rights of consent, impeachment, censure, correction, and audit) has found substantial evidence of collusion among construction companies operating in the country (Chang, 1992).

Since customers may become too attached to the list of pre-qualified contractors. This is a risk to the contractor since their markets become restricted. The pre-qualification stage then constitutes a major areas where the construction company can act strategically to reduce the risk of losing business opportunities.

4.9. CONCLUSION

The process which leads to contractual commitment in the construction industry evolves through sequential stages which are similar to those in a new-buy process for an industrial product. The evolution of construction purchase decision also involves many people and factors like those involved in a buying decision process. It is essential that the contractor understands the nature of these stages. A better understanding of these stages is an important opportunity for the contractor to reduce the risk involved in the contract selling process.

In this chapter, we have only discussed three 'critical stages', the 'precipitation stage', 'design stage' and 'pre-qualification stage'. Two of the critical stages, 'tendering stage' and 'commitment stage', which are related to the third and fourth hypotheses (H3 and H4) respectively, are carefully discussed in the following chapters.

CHAPTER FIVE: THE TENDERING STAGE

5.1. INTRODUCTION

The usual climax of a normal business transaction is the acceptance or purchase of goods or services offered at some price. Both the price, and the goods or services, on offer are important in any business transaction. In the construction industry, this importance is heightened since most standard construction contracts are awarded on the basis of price, and the contract is not considered as successfully executed until the product is accepted by the client.

The most common method used in construction is an open competitive tender where advertisements solicit tenders from any contractor. In general, the lowest tender is accepted (Hillebrandt, 1984). In 1989, more than half of the construction contracts (59.5%) were awarded through traditional competitive tender in the UK (RICS, 1991). Although it is forecast that procurement methods will move away from the traditional design-tender-build method, the traditional method of procurement will continue to be the preferred approach for the foreseeable future (Fellows and Langford, 1993). Since most construction contracts are awarded through competitive tendering the tendering stage constitutes an important areas where the contractor can apply risk management strategies. This chapter will focus on these strategies.

5.2. TYPES OF COMPETITIVE TENDERING

While project is being designed the main designer and quantity surveyor may advise the client on the best method of appointing contractors. The Banwell Committee identified three important factors in choosing an appointment methodology (NEDO, 1968):

1) Efficiency of selection, i.e. appointing the most suitable contractor for the job, obtaining value for money and ensuring economy in the tendering process.
2) The possibility of early selection of the contractor so that he can participate in the design and planning process.
3) The provision of continuity of work for the contractor, aimed at producing savings in which the client should share.

The most commonly used methods for appointing contractors identified by Seeley (1986):

* Open competitive tendering
* Selective tendering
* Two-stage tendering

No matter what method is used, Drew and Skitmore (1993) suggest that, the contractors selected will:

1) be prepared to undertake and complete the work at a competitive price.
2) complete the work on time.
3) construct the work to the required quality standards.
4) execute the work without significant risk of extra financial burden on the client.

5.2.1. Open Competitive Tendering

This method is often used by both public authorities and private clients to obtain tenders by advertising in the general press and technical journals, or through the local branch of the Building Employers Confederation. Under the rules of the European Economic Community contracts for public works exceeding a certain threshold value (excluding VAT and the value of nominated sub-contracts), must be advertised in the official Journal of the European Communities before tenders are invited (Williams, 1992; The Aqua Group, 1986b). Any contractor who responds to the advertisement is supplied with the tender documents. A deposit is usually requested which is returned on receipt of a *bona fide* tender. Ideally, tenderers should be informed when the tender documents are issued of the number of contractors to whom issue has been made. Although the lowest tender is usually accepted, the client is not bound to accept the lowest or any tender (Seeley, 1986). However, there is often some reluctance not to do so and it is particularly difficult not to where public money is involved (Pilcher, 1992).

This method's advantages are its apparent fairness and low initial cost to the client. Its disadvantages, however, generally outweigh the advantages. First, that is no guarantee that the contractor with the lowest tender is technically, managerially or financially capable of doing the job. If not, the cost of remedial work may outweigh any benefits from the lower initial price. Second, it may yield a large number of tenderers with much abortive tendering and waste of resources. Although the Wood Report (NEDO, 1975:54) advised against open tendering, it is still used in public-sector work. The Wood Report stated:

> "We cannot, however, endorse the continued use of open competition. It has little to offer over some form of selection prior to invitation to tender, and we cannot entertain any justification for its continued use in the face of repeated condemnation in past reports, and the poor performance on such contracts in our statistical survey."

5.2.2. Selective Tendering

Selective tendering based on approved lists or pre-qualification has been recommended as the most effective method for selecting contractors (ICE, 1983). It offers a popular and relatively straightforward procedure, affording maximum efficiency and economic advantage, and ensures the receipt of meaningful tenders (Seeley, 1986).

In this method, lists of contractors suitable for specific categories of construction projects are compiled by the client and consulting engineers, then tenders are invited from contractors chosen by the main designer and the client concerning their technical competence, their financial standing, the resources that they have at their disposal and their relevant experience (Pilcher, 1992). The objective of selective tendering is to limit the number of tenders to a manageable level. Taking all factors into account, the principle of selective tendering has become established for major construction contracts, with provision for the standing of qualified contractors to be reviewed in the light of their performance and to give contractors opportunities for continuity of working (Yeadon, 1985).

Tendering is expensive and the costs increase with the size and complexity of the project. Hence, the larger the project the fewer should be the number of tenders. A NJCC (National Joint Consultative Council) Code recommends that a short list should be drawn up from the approved list of contractors of established skill, integrity, responsibility and proven competence for work of the character and size contemplated (NJCC, 1985). It is interesting that the NJCC Code recommended that the maximum number of tenderers should be:

* for contracts up to £50,000: 5
* for between £50,000 and £250,000: 6
* for between £250,000 and £1m: 8
* for greater than £1m: 6

It has become accepted practice with civil engineering projects to invite from four to eight contractors to tender for a project (ICE, 1983). Although the practice of inviting tenders from a list has the principal advantage of eliminating the worst features of open tendering, it does make it difficult for reputable contractors to enter new fields.

5.2.3. Two-stage Tendering

Two-stage tendering is another method of choosing a contractor early on the basis of expertise, resources and site organisation as well as price. A recent study by Fellows and Langford (1993) indicate that most clients (72%) and contractors (71%) confirmed that two-stage selective tendering was the dominant method of contract selection.

The first stage involves the competitive selection of the contractor, while the second stage determines the price based on data obtained from the first stage. Sufficient information is supplied to tendering contractors to establish the basis for the final price. Normally, the contract price is determined through negotiation between the client and the contractor.

In some instances the first stage is preceded by a preliminary stage in which the contractors are interviewed to determine their resources and the contributions they can make. The main advantages of two-stage tendering are (Seeley, 1986):

* Early contractor selection accompanied by a quicker start and completion of the contract.
* Detailed pricing is known after the first stage, following the receipt of competitive offers, and this can be used in determining the contract price at the second stage.

* There are benefits at the design stage with the availability of the expertise and experience of the contractor and his organisation.
* Construction may start before the design is complete, although there are risks inherent in so doing.

Two-stage tendering methods are assessed in the Wood Report (NEDO, 1975) and in the Wilson Report (NEDO, 1974) for the private sector.

5.3. PLANNING THE TENDER

Since it is the client who initiates the demand on the contractor, the business of tendering has been considered from the client's viewpoint. The contractor's viewpoint on the work and problems involved in tendering is important too.

A tender is the most important piece of 'advertising copy' which a firm ever issues (Marsh, 1981). Unlike most advertising material, it can be guaranteed to be read, and usually by the people who matter most. A tender is a vital opportunity for the contractor to promote himself and his products for the particular job in question and for future work as well.

Tendering is also an essential step in the chain of turning plans into physical action. There is more to tendering than the setting down the specification, prices and terms of the offer. There is also the psychology of the client to be considered. The importance of this tender in relation to the market and the likely reactions of competitors to be considered. However, because the preparation of tenders is both expensive and time consuming (Ashworth, 1991), the contractor will normally first:

* Make a careful study of the enquiry documents.
* then, and on the information gained through normal commercial intelligence channels, and depending on his existing and projected work load, decide whether to treat the enquiry seriously or not.
* If the decision is to take it seriously, then prepare a tender plan.

The objective of planning the tender is to submit an offer which:

* is the most attractive to the client;
* minimises the contractor's risks and potential liabilities and ensures a reasonable profit.

Clearly these two objectives will at times be in conflict. It may be attractive to the client to guarantee a shorter delivery than one's competitors, but if the damages for delay are heavy the tenderer must be very certain of completing on time for the risk to be commercially acceptable. Tendering like purchasing is a compromise. Moreover, it is a compromise which normally has to be worked out against a tight time scale and take into account the company's competitors. It also costs time and money and is a commitment of a company's resources.

Planning the tender may be considered in two stages. First, the decision whether to tender, and second, if so, the planning of the tender itself. The first issue of whether to bid or not is covered in the *Contract Negotiation Handbook* (Marsh, 1984). Details of tender planning are covered by NEDO (1968), Marsh (1981), ICE (1983), Yeadon (1985), Haslam (1985), Myers (1985), The Aqua Group (1986a), and Stone (1988).

5.4. THE CONTRACTOR'S BID AND ITS LEGAL IMPLICATIONS

All the efforts planning the tender is to submit a successful bid and ensures a profit. In essence, a bid is a binding offer to furnish specified goods and services for a specified cost and time (Rubey and Milner, 1966). To speak of bid, it is necessary to understand the definitions of the words 'contract' 'offer' and 'acceptance' first. *The Oxford English Dictionary* (Oxford University, 1961:912) has defined the contract as:

> "A business agreement for the supply of certain articles or the performance of specified work at a certain price, rate, or commission."

Seeley (1986:4) has also mentioned that -

> "A simple contract consists of an agreement entered into by two or more parties, whereby one of the parties undertakes to do something in return for something to be undertaken by the other. A contract has been defined as an agreement which directly creates and contemplates an obligation."

Stone (1988:86) has stated that -

> "A contract may be defined as a bargain between the parties, whereby one party agrees or promises to do something (such as to supply equipment) in return for the promise of the other party (usually, to pay the price)."

Stone also used the terms 'offer' and 'acceptance'. He stated that an 'offer' is a statement that the person making it is willing to contract on the terms stated, and that an 'acceptance' will conclude a contract, if it agrees to the same terms as the offer without any qualification or addition. Now, we can continue to discuss the bid and its legal implications.

In view of the buying process, the tendering stage is a phase during which the buyer invites the sellers to submit their proposals to produce a particular product for him at some price. These prices are supposed to consider the details which the buyer provided about the required product. The buyer is assumed to be aware of the 'true cost' of the required product and uses that to evaluate the prices submitted. The seller who has submitted the lowest price usually is selected to produce the product.

A bid is thus an offer to accept a contract and execute the specified work at the price submitted. This offer may become a binding contract if the buyer accepts it (Watson, 1979). Thus, once 'offered' by the seller and 'accepted' by the buyer without any preconditions, a bid becomes legally enforceable.

When a construction company makes a bid it is committed to enter a contract at its bid price if it wins the contract. Normally an offer may be 'revoked' or withdrawn at any moment prior to acceptance; and, generally, a contract will not exist until the acceptance is communicated to the bidder.

At the bidding stage the contractor's decision to withdraw an offer is a risk-avoiding method, though this is often ignored. When a contractor perceives and realises new risks not estimated in an offer submitted for a particular project, he can withdraw the offer as soon as possible before it legally takes effect to avoid possible losses if he wins the contract. In view of the importance of timing to take these actions and avoid disputes, English law lays down the following rules (Williams, 1992):

* An offer takes effect when it is received by the offeree,

* The withdrawal of an offer takes place when it is received by the offeree,
* An acceptance is complete when it is posted by the offeree.

It is also important to note that very few contracts in English law need to be made in writing, and that commercial contracts may be oral, written or by conduct (Stone, 1988). However, the present practice in the construction industry suggests that it is the wording of the contract that may reinforce or neutralise a bid's legal implications. The wording of the contract in terms of the types of clauses included may become a risk factor for a contractor. The inclusion of the clause in a contract may lead to unpleasant financial consequences for the contractor concerned.

5.5. THE RISK IMPLICATIONS OF PRICING

In most cases, the most important criteria for selecting contractors is the bid. Fellows and Langford (1993), Baker and Orsaah (1985) have emphasised the importance of 'the lowest contract price' as a winning factor. Flanagan and Norman (1993:135) state that -

> "Competition is based upon price ..... in Western culture it is the price that eventually determines who does the work."

However, the lowest cost tender is not necessarily the best (Stone, 1988). Warby (1984:201) quotes John Ruskin:

> "It is unwise to pay too much, but it is worse to pay too little. When you pay too much, you lose a little money - that's all. When you pay too little, you sometimes lose everything, because the

thing you bought was incapable of doing the thing it was bought to do..... If you deal with the lowest bidder it is well to add something for the risk you run."

Thus, the clients accepting a bid also accept a risk. The contractors too are at risk when they submit bids. Contractors who receive an invitation to tender will give their best effort to preparing the tender. Preparation of the tender is time consuming work and uses the firm's resources, perhaps one percent of the total bid (Rubey and Milner, 1966). If contractors bid too high they risk losing work, while too low a bid may lose money, or even lose work. In either case, poor bids can lead to failure. The risks submitting a bid are so serious that this stage has become very important.

5.5.1. Risk Implications In Marketing

Marketing is a function of management in construction industry as in any other industry - selling the company, its services and its good name. However, Hillebrandt and Cannon (1990) indicated that the construction industry has been very slow to recognise marketing as a tool to improve performance in terms of profitability, market shares or sales volume. Marketing has two distinct but complementary functions (Calvert, 1986):

1) Marketing strategy - finding out what people need or want, organising the resources of the firm to fulfil these needs or wants, while determining suitable policies so that both the buyer gains and the seller profits from the transaction.

2) Selling tactics - the executive task of employing appropriate techniques to sell the product or services, i.e. obtain orders or contracts.

From the view of the second issue - selling tactics, the tendering stage provides an opportunity for the construction firm to apply marketing by submitting the lowest bid price in order to make a sale. In other words, the tendering stage provides an opportunity to test a firm's ability to assess the relationship between the price and the customer's likelihood of accepting that price. However, the ability of the firm to do this is not known until the commitment stage is reached. What is known at the tendering stage is the customer's acceptance or rejection of the bid.

The marketing implication of the tendering stage is also reinforced by the 'non-recoverable' nature of lost sales (James, 1972). One aspect of marketing is that once a sale is lost it cannot be recovered. In other words, it is lost forever. It could be argued that contracts can be terminated and reawarded to another firm but it would be impractical for the seller to wait for such situations to occur. The tendering stage therefore offers the seller the opportunity to co-ordinate and apply its marketing effort to make a sale - offer a good bid and win the contract. However, the firm must bear in mind the 'non-recoverability' of lost sales.

Nevertheless, Fellows and Langford (1993) indicate that clients are becoming less price sensitive and placing more attention on the contractor's performance record, past relationships, financial stability and the expertise of its personnel. Experienced clients often forge permanent relationships with contractors to provide for their construction needs. Therefore, all contractor's personnel must be part-time marketers where long term, integrated relationships are sought. Fellows and Langford also indicate in the same work that some contractors argued that the creation of such relationships were unhealthy in that they eliminated competition. They asserted that the best 'deal' for a client is obtained through competitive tendering.

5.5.2. Risk Implications of Different Bid Prices

Stark (1971:484) described the importance of competitive bidding as:

> "Competitive bidding is fundamental to our economic system. Better bidding policies, aside from direct advantages, increase the likelihood that more efficient bidders win contracts and prizes. This is of fundamental importance to the quality of a free-enterprise system."

Stark suggested that a successful and acceptable bid price is important to individual companies, and to the whole economic system. Bonny (1973a:34) also described bidding as:

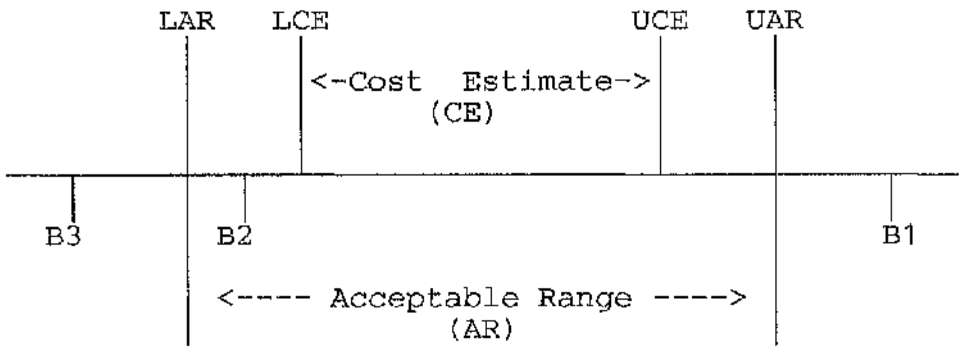
> "Bid strategy is the most difficult of all the functions of management to define. It is the least subject to the rules of logic, impossible of scientific engineering analysis, and yet basically so important that an average contractor with a fair knowledge of the business and a competent organisation who lacks an adequate concept of the art is almost foredoomed to failure."

Bonny emphasised the difficulty and complexity of the decisions in the tendering stage, and the inherent risks of submitting a nonacceptable bid. Basically, a misjudged price in a construction project is defined to include the following:

1) a bid price which is too high for the client to accept.
2) a very low bid which is acceptable to the client but at which the contractor cannot produce the required product without a loss.
3) a bid price too low for the client to accept.

These situations are illustrated in Figure 5.1.

Figure 5.1. Three Situations of Misjudged Bid Price



The actual cost of a construction project is rarely known until that project is completed. Consequently, the client of a construction project makes his cost estimate (CE), not in terms of a rigid fixed amount, but within a range. Situation (1) is represented by a bid price B1 which is far above the upper limit of what the client is prepared to accept (The Acceptable Range AR). Situation (2) on the other hand is represented by the bid price B2 which is below the lower limit of the client's cost estimate (LCE). However, since B2 is within the lower limit of AR, this bid is likely to be acceptable to the client. Situation (3) is represented by a price B3 which is below even the lower limit of acceptable range (LAR). Each situation presents its own risks.

The risks of situations (1) and (3) for example, is that the construction company stands very little chance of winning the contract. Thus the risk of not winning is associated with situations (1) and (3). Situation (1) with the bid price of B1 would lead to a large profit should the company win the contract. However, because the price is outside the upper limit of the acceptable range (UAR) it is most likely to be rejected. Situation (3) where the bid price is B3 would obviously undercut other bidders. But because the price is abnormally low, it is likely to raise the client's suspicion about whether the contractor understands the nature of the work involved. He is therefore likely to reject the bid.

Situation (2) on the other hand presents a price B2 which is just below the lower limit of the client's cost estimate (LCE). However, B2 is within the acceptable range (AR). Therefore, assuming that this is the most acceptable to the client, the contractor with that price wins the contract. Since B2 is below LCE. This implies that although the contractor has won the contract he will most likely produce the product at a loss assuming the client' cost estimate (CE) is correct. Thus the risk associated with this situation is the risk of winning bids and losing money. The risk of winning and losing could sometimes occur as a deliberate strategy by a firm to gain experience in some areas of construction where this is considered crucial.

There are cases when the differences in bid prices of a given number of competitors are considered insignificant. In such cases, the client is likely to consider other factors as well. Previous experience has been found to be very important to clients (Bonny, 1973a).

In all three situations, the risk implications could be serious. Failing to win a contract because of price, for example, could waste effort and resources, but also risk idle capacity. Because of these risks arising from a poor decisions in the tendering stage, various quantitative models have been developed and studies undertaken to reduce or manage these risks. Some of them are described next.

Based on above discussions and findings, hypothesis H3 is formulated:

H3: The tendering stage is the most important phase for applying risk management primarily through an effective bidding/negotiating approach.

Hypothesis H3 is further elaborated as follows:

H3a: The preferred mechanism for letting contracts is the traditional competitive two-stage tender.

H3b: Active information seeking is used by contractors in preparing their bids as a risk management method. There is a positive relationship between the perception of risk and the search for information.

H3c: Price is the most important factor in winning contracts.

H3d: Contractors prepare for negotiation as a risk management method. There is a positive relationship between the perception of risk and the level of preparation for negotiation.

H4e: Similarity in the negotiators' background eases negotiations and reduces risk.

5.6. BIDDING THEORIES AND MODELS

Friedman's (1956) *A Competitive Bidding Strategy* presented the first probabilistic approach to competitive bidding. The theory states that maximum expected profit is the criterion to use when pricing a bid. Since that time, a considerable volume of operational research literature has dealt with the problems of competitive bidding. Examples include those of Gates (1967), Morin and Clough (1969), Whittaker (1971), Curtis and Maines (1973), Oren and Rothkopf (1975), Reece (1979), Ramsey (1980), Skitmore (1989), Drew and Skitmore (1993), and a host of others (Stark, 1971).

Some of these concern auction or leasing problems, not directly relevant to construction, however, their basic objective remains the same as those which were developed purposely for the construction industry.

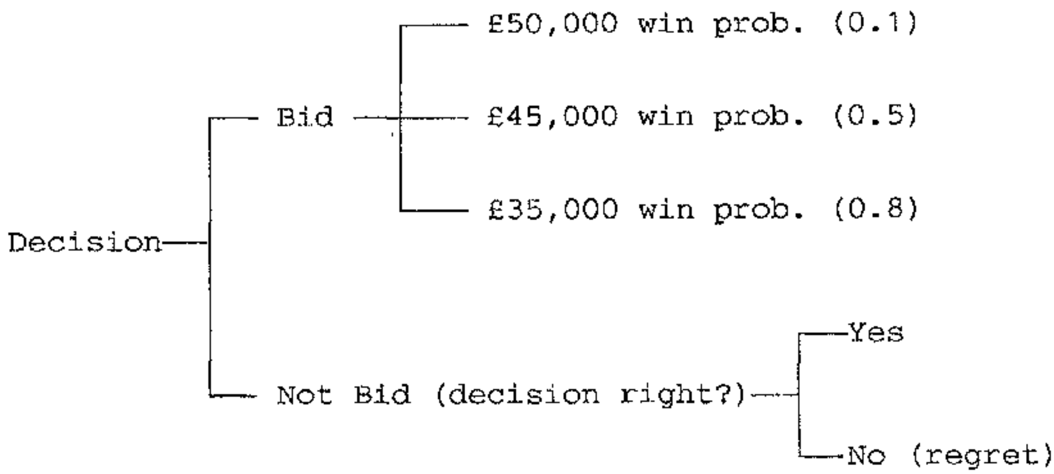
5.6.1. The Fundamental of Bidding Model

Every company has limited resources both physically and financially. Equally, every company has a number of potentially desirable activities in which they could be employed. A business's ability to make profits depends on how effectively it utilises its resources by concentrating them on those activities which will provide the maximum return for effort expended. The distinguishing feature of resources used at tendering stage is that they are profitably employed if the bid is successful. If the award is lost then the resources have been wasted in the sense that they have made no contribution to income.

Therefore the control of bidding effort is a vital management decision which involves taking following two criteria into account: bid desirability and success probability (Marsh, 1984). In other words, the first important decision is, whether to bid, or not to bid. Having decided that the company should bid for the contract, the next important decision is, how much should the company bid. The two parts of the decision are illustrated below in Figure 5.2.

For example, as it can be seen from the diagram, a no-bid decision will stop any further action concerning that particular contract. However, if the contractor later realises, perhaps too late, that he has taken a wrong decision, he regrets his decision since this has led to a loss of an opportunity to secure a possible profitable contract.

Figure 5.2. Decision Diagram of Bidding Process



If, on the other hand, after a preliminary examination of the specific contract and consideration of the firm's position and market environment, the contractor decides to bid for the contract, then the next question he will normally ask is 'how much'. Now let us have a look at the following two expressions first.

1) $F = B - C$

2) $E = P\ (B-C) = P * F$

Where

B represents the contractor's bid.

C represents the estimated cost of the contract.

F represents the estimated profit.

E represents the expected profit if the contractor wins the contract.

P represents the probability of winning the contract with bid B.

Because the contractor is not sure of winning, his certainty of winning is just an assigned probability. Suppose the contractor in Figure 5.2. has decided to bid, but he has to decide on one of the three alternative bids, B1, B2 or B3, and C is constant, say £30,000 here.

Bid	**Bid Price**	**P**
B1	£50,000	0.1
B2	£45,000	0.5
B3	£35,000	0.8

Using the formula derived above, the contractor's F and E would be as follows:

Bid	**F (£)**	**E (£)**
B1	20,000	2,000
B2	15,000	7,500
B3	5,000	4,000

From previous analysis an abnormally high price will lead to more profit, the probability of being successful in a bid with such a high price is relatively very low. Conversely, while an abnormally low price may have a relatively high success probability, this may lead the contractor to incur a loss or unsatisfactory level of profit on the contract. Between these two prices therefore, there is a price which represents optimum trade-off between profitability and success probability.

Our contractor in the example is assumed to be concerned only about the bid which will yield the highest expected profit (E). He is therefore most likely to submit bid B2 since he is not concerned about competition. In practice however, the contractor will be faced with many competitors. This will affect the probability of winning too. Therefore his primary concern will most likely be:

* First how to submit a winning bid, and
* Second the bid will yield some profit.

Basically, the main objectives of most competitive bidding models seem to centre around this twin problem some placing more emphasis on profit, and others emphasising more the need to undercut competitors with a low bid price without necessarily abandoning the profit motive. The latter group seems to be closer to what actually happens in the construction industry. Grinyer and Whittaker (1973:181) emphasise the critical importance of the bid prices:

> "Clearly, the prices bid are of critical importance to the prosperity of the firm. If they are too low, contracts upon which low or negative profit may be borne are obtained. If too high, the firm fails to gain the contracts and may ultimately be driven out of business."

5.6.2. Review of Some Aspects in Bidding Models

The Suitability of Statistical Technique

In the model which Friedman (1956) proposed, he hypothesised the existence of an objective function and a probability of winning function - both functions of the bid price. He then showed that the value of a bid was the probability of winning the bid with a given bid times the profit to be achieved if the firm won the contract with that bid. In other words, the bid price which maximised the expected value of the objective function is the optimum bid price.

According to Friedman, one way of determining the probability of winning with a given bid was to study the historical bidding patterns of competitors. Friedman assumed that by keeping a record of the competitors' past bid it is possible to evaluate its bidding habits, by tracking competition we can develop its bidding behaviour and that history usually can be used as a basis for predicting competitive bid levels. Friedman's suggestion that the historical bidding patterns of competitors should be used to determine the probability of winning in a given contract seems reasonable but unrealistic. Because it is difficult to obtain data on the historical bidding patterns of competitors. Certain aspects of bid information are not normally given out. It is not surprising, therefore, to find some criticism of this approach as construction project bidding is concerned.

One major criticism is that the events taking place are not truly random in the classical statistical sense as the basis of classical statistical theory is that there is an experiment that can be repeated many times in order to gather data from which the parameters of the probability distribution of some random variable of interest can be estimated (Skitmore, 1989).

Benjamin (1972) indicated that a sequence of bidding situations is not a sequence of repetitions of the same experiment since each job is unique. Empirical criticisms are more serious. It has been claimed, for instance, that the assumption of randomness is invalid as we know that many subjective factors influence bidding behaviour (Curtis and Maines, 1973). Spooner (1971) has also suggested that a random selection process is not a rational representation of behaviour in these circumstances.

Number of Competitors

From Friedman's model (1956), we know that he was more concerned about the probability of winning over a given number of competitors than the establishment of an optimum profit bid price. Usually, the firm is often uncertain about the number of competitors in a competitive bidding situation. Friedman himself should have realised this when he suggested the use of the 'average *n* competitors'.

According to Friedman, where there was more than one competitor, the probability of winning would be the probability of winning over the first competitor times the probability of winning over the second competitor times the probability of winning over the last competitor. Thus, in such a case, the probability of winning would be the probability of the firm winning over one 'average' competitor raised to the *n*th power.

That there are serious difficulties with such an approach becomes evident when the case of *n* identical parties to the competition is considered. In that case each party can find a bid for which the probability of beating each of the others is $^1/_2$. The Friedman model assigns to each the probability $(^1/_2)^n$ of winning, whereas identical parties using identical strategies should each clearly have probability $^1/_n$ of winning. Gates (1967), Bristor and Stark (1968), Oren and Williams (1975) have also commented on that paradoxical nature of the Friedman model.

The paradox is more concretely seen if we think of a race with three horses, each with equal running abilities. Horse A will beat horse B with probability $^1/_2$; he will beat horse C with probability $^1/_2$. According to Friedman's model, we would conclude that horse A will win with probability $^1/_4$ rather than the correct $^1/_3$.

Factors Affecting the Likelihood of Winning the Bid

The competitive pressures in the construction industry, it has been said, are probably more intense than any other industry (Park, 1972). In the presence of such competition it is not surprising to find that some companies believe competitive bidding does not result in competition based upon costs or profit margins but produces a lottery in which the inherent uncertainty of the process decides the winner (Whittaker, 1971). Indeed, McCaffer (1976) has found substantial evidence that existing bidding processes are little more than random.

This would suggest an extremely simple model in which the probability P of entering the lowest bid is the reciprocal of *n*, the total number of bidders. The value of *n*, however, may not be known with certainty but may be modelled by a probability density function. Research by Broemser (1968), however, indicates that *n* is not significantly correlated with P. Empirical attempts to link other factors with P have also made by Gates (1967) and McCaffer (1976). For instance, Gates examined the influence of project size, and found that there is no evidence that the number of bidders for a construction project is in any way related to the magnitude of cost of the project.

Morin and Clough (1969) acknowledged the need to investigate the effect of influential variables on winning contracts in competitive situation. Their OPBID (OPtimum BID) model emphasised six variables, namely -

1) Cost estimate
2) True cost
3) Mark-up
4) Number of competitors
5) Identity of competitors
6) Class of work (highway, building, etc.)

Although these variables have been interpreted mainly in terms of their contribution to the winning of contracts, there is no doubt that the effects of some of these variables go beyond the bidding stage. However, the most popular factor that has been associated with P is the difference between the bid and cost estimate, commonly termed the 'mark-up' (Skitmore, 1989), which covers overheads, profit and risk (Curtis and Maines, 1973). Such overheads cover the cost of the site management and supervision, offices, canteen, cars, temporary roads and services, and the company management and administration (Pilcher, 1992). Skitmore (1989:160) has stated that -

> "The degree of mark-up will also have a bearing on the likelihood of acquiring the project."

Cooke (1992:61) also maintained -

> "For each marginal change of mark-up there is a corresponding change in the probability P of success."

According to Curtis and Maines (1973), the bidding process requires each competitor to calculate his cost estimate, and multiplies it by his mark-up. The bids are compared and the lowest bidder wins the contract. Suppose that in a particular contest we bid a price B1, and our competitor bids B2. Our price is made up of our cost estimate C1 and our mark-up M1, which can be defined multiplicatively so that B1=M1*C1. Then we win the contract if B1<B2, i.e. if $M1 < {}^{B2}/_{C1}$. So by plotting a frequency distribution of ${}^{B2}/_{C1}$ for all the contests in which we engage, the probability of winning a contract with a mark-up M1, against one competitor can be obtained.

In developing such a model, a bidder needs to feed into two major variables - his cost estimate and his mark-up. Traditionally, contractors' estimating departments expect to get within a few per cent of the 'actual cost'. It is important to note here that it is impossible to determine this distribution exactly. A further difficulty that arises with such a model is that estimated cost and mark-up are expected to be independent. In real life, the assumption that estimators work in isolation and are not affected by changes in mark-up policy or other factors is not true. Therefore, the model of Curtis and Maines is not very realistic.

In the past twenty years, both industry and academia have become interested in the bidding models. Several models (Skitmore, 1986; Sugrue, 1980; Curtis and Maines, 1973; Whittaker,1971) have been proposed for the construction industry decision-maker, but it is common for research papers to develop a thesis, usually in the form of a mathematical model, without adequate mention or consideration of underlying assumptions and characteristics of the environment. In many instances, these assumptions are demonstrably untenable (Skitmore, 1989). What is needed is a model that reflects the truly pivotal factors in the environment being modelled. But Skitmore (1989) indicates no existence of any such substantive model. Hillebrandt and Cannon (1990:73) report results from a study in which twenty contractors in the UK participated (They were among the thirty-five largest companies reckoned by turnover). They found that:

> "No company used any computer programmes to determine bid price ..... They did not make any calculations on a model basis for any contract."

5.7. CONCLUSION

This chapter has broadly discussed planning the tender, submitting the bid and their risk implications. It also discussed some aspects of bidding theory and the bidding model. Obviously, the subject of 'tendering/bidding' crosses many and varied fields of study. The following points have emerged:

The tendering stage involves many people and factors. Other contractor's competition is an important factor among them. The optimal profit that a contractor should add to his bid is partly determined by the contractor competition for the project. A contractor's winning or losing a project contract often depends on how well he has formulated his information about his competitors. A contractor must always search for information to gain an advantage over his competitors. Formulating the information is often referred to as determining a winning bid.

Although statistical models would appear to be useful in deciding approximations of successful bids, they are regarded as theoretical techniques and not easily, reliably applied within the construction industry in real bidding due to their complex and uncertain nature. In recent years there have been few attempts to develop contract bidding models. contractors would be unwise to rely on a statistical tool over own hard-won experience.

The tendering stage is one of the critical stages in the selling process for construction. It offers the firm the opportunity to apply its risk management strategy through balancing high and low prices with their attendant rewards and risks. In this regard therefore, price constitutes the most important variable in the bidding strategy of the firm.

CHAPTER SIX: THE COMMITMENT STAGE

6.1. INTRODUCTION

The commitment stage or execution stage starts when an offer is formally accepted by the client and the acceptance of the offer is communicated to the contractor who made the offer. Now, a legally binding construction contract is established. The contractor must commit himself to the project and execute all the construction work in accordance with the manner set out in the specification.

In the preceding chapter, we have shown that the tendering stage is critical in the contracting process for a construction project. Bidding models and the bid itself cannot provide comprehensive insurance against all the inherent risks which the contractor may later face in the commitment stage. This is because the commitment stage involves so many people and other factors, many are not only outside the control of the contractor, but also are so erratic that their behaviour cannot be predicted with certainty.

A successful execution of the commitment stage is essential to ensure customer's post-purchase satisfaction, both in terms of contractor's performance on the execution of the contract on time and budget, and the quality of the delivered product. A successful execution of the commitment stage also requires human, managerial and intuitive judgement to handle the problems which they may create.

This chapter will discuss the commitment stage and its risks which cannot be handled in the tendering stage. The whole emphasis of the discussion will be concerned with the following factors:

* the contract placing and its forms;
* the planning of the production activities;

* the purchase of the required materials;
* the production and delivery of the required product within budget and time;
* the potentials for disputes; and
* the post-purchase satisfaction of the client.

6.2. THE PLACING OF THE CONTRACT AND ITS FORMS

In order to formalise a relationship between the client and the contractors the conditions of their appointment are usually set down in a contract. De Benedictis and McLeod (1973:45) have described the construction contract as:

> "A construction contract is a contract under which one party promises to furnish services and materials to build a structure or to improve real property for another party who promises to pay for the work performed."

Pilcher (1992:30) simply defines the construction contract as -

> "A construction contract is a binding agreement, enforceable in law, containing the conditions under which the construction of a facility will take place."

A construction contract specifies the responsibilities, liabilities, method of payment and apportionment of risk between the parties in achieving the desired objectives relating to quality, time and cost. The placing of the contract is a relatively simple routine matter (The Aqua Group, 1986a) but the events which follow immediately afterwards are of great importance. A variety of contractual arrangements are available and the client needs to carefully select the form of contract which is best suited for the particular project. Conditions of contract are included within the contract to express the relationship between client and contractor and to define explicitly what is to happen should that relationship be disturbed by the failure of either party to fulfil their obligations.

Projects which are complex in design or construction require more precise and comprehensive contractual arrangements. Complexity may be the result of an innovative design, the utilisation of new constructional methods, the phasing of the site operations or the necessity for highly specialised work. It can also be the result of employing several contractors on the same site at one time in order to achieve rapid progress or the complicated refurbishment of an existing building while still in use by its occupants. It is often necessary in circumstances of these types to devise new contractual arrangements.

The form of construction contracts varies from contract to contract. Some are short and simply stated; others are long, detailed, and involved. Some cover small, inexpensive projects; others cover huge, costly projects of long duration. The choice of a particular form will depend upon the circumstances surrounding the project.

The construction industry, like other industries, has developed standard forms of construction contracts which have eliminated much of the need for custom-tailored agreements (Cushman et al, 1983). The standard forms of contract in use within the construction industry are drawn up by committees who have representatives from most of the interested parties. Clients, contractors, specialist contractors, and local authorities are all represented. Standard forms of contract have several advantages. Many have been thoroughly tested in practice and each party in the construction industry is familiar with their particular roles and responsibilities. These contracts have an established case law and precedent and all participants can be confident that their legitimate interests are protected. Moreover, standard forms of contract cover most of the risks in construction and specified allocations of risk are intrinsic to these standard forms. These standard forms represent a compromise (Flanagan and Norman, 1993).

Most of the conditions governing the conduct of such contracts have already been laid down by various professional bodies concerned with the construction industry. Such professional bodies include:

* The Joint Contracts Tribunal (JCT),
* The National Federation of Building Trades Employers (NFBTE), and
* The Institute of Civil Engineers (ICE).

JCT 80 (The Joint Contracts Tribunal) is the most frequently used form for building contracts and the 'ICE Conditions' (The Institute of Civil Engineers) is the equivalent in the civil engineering industry (Ashworth, 1991). Many in the industry feel that the use of a standard form will help people to become more familiar with all the contractual provisions. Unfortunately, this ideal is rarely achieved because the standard forms are rarely used as printed (Murdoch and Hughes, 1992). It is common in the industry for people to amend the printed form, by striking out clauses they do not like and adding in their own preferred clauses. It is also possible for a client to use a special contract of their own in spite of the advantages of standard forms of contract. Although contracts specially drawn up by clients can be expensive to prepare and the implications of the clauses uncertain (NEDO, 1974). Non-standard forms of contract need to be thoroughly checked to ensure that all the participants' interests are properly protected. Architects, engineers, quantity surveyors, or solicitors familiar with construction contracts can be employed to carry out this scrutiny.

Central, Local Governments and Public Utility Companies like to use special contracts with their own amendments and additions which may override the general principles of practice (Wood, 1971). These contracts generally impose a greater share of the risks and responsibilities involved in the design and execution of the works. They are not intended to be fair or balanced but rather to protect the client's interests (Marsh, 1981). However, this suggests that contractors may negotiate favourable terms or guard against certain risks in the wording of the contract. Clauses dealing with certification of payments, granting of extensions of time and determination of whether or not work is defective may be tailored to meet specific needs.

The wording of the contract is important since it determines the conditions placed on the contractor: the work to be produced and when to deliver the specified product. The importance of the contract form should not be over-emphasised. NEDO (1983:4) has stressed this viewpoint by pointing out that -

> "It is not the form of contract which primarily determines whether targets are met, but the attitude of the parties, to which the form of contract may contribute."

All contractors must realise that it is the understanding of contract conditions, and, if necessary, the ability to influence them, which is essential for successful operations.

6.3. THE MANAGEMENT OF THE CONSTRUCTION WORK

The commitment stage or execution stage is the stage which uses the designs, drawings and specifications to create the physical product. Hillebrandt (1984) has described how many foremen or managers have to make many *ad hoc* decisions because of the large number of inputs on to a construction site, the fact that each project is a one-off operation exposed to the vagaries of the weather, and the difficulties of managing large numbers of men possibly working together for the first time. Moreover, because of the diversity of conditions from one site to another, foremen and managers often have to take decisions based on personal knowledge and experience, without reference to senior personnel at head office. What Hillebrandt emphasises is the complexity of the construction project and the needs for an overall management.

The production cycle in construction is long with many diverse matters to be dealt. Construction operations are becoming increasingly complex as a result of improving technology so that the construction of a structure calls for coordinated effort by the management and all parties. For example, the PBS/GSA (Public Buildings Service of the General Services Administration) has described the complex management problems of modern construction projects in its handbook *The GSA System for Construction Management* (GSA,1977). This provided an extensive discussion of how construction management skills during the commitment stage of a construction project.

There is a great variety of theories about, and methods for organising the production process each with its different contractual relationships and procedures. Success depends on having the right relationships between all parties in the process and requires innovative thinking to deal with the project (Hillebrandt, 1984). Factors commonly thought to be essential during the production phase are:

* The contractor's own workforce
* The sub-contractors and their workforces
* The owner and/or his representative
* Materials, equipment and suppliers

These factors can further be grouped into two sets:

1) the human side, and
2) the materials and equipment side.

Despite the advances made in developing equipment, construction is a labour-intensive industry and is likely to remain so for the foreseeable future (Fellows et al, 1991). The management of staff and operatives is critical to the success of any business. The personnel function can be an important factor in construction management (Calvert, 1986). However, Hillebrandt and Cannon (1990) observed that construction companies focus on financial resources and paid too little attention to human resources. In discussing the human side as a separate factor in construction contract, it is important to remember that neither the human factors or the materials and equipment factors can function effectively on their own. Maher (1982) has stressed the importance of the relationship between labour, materials and equipment units during the production of a construction product. To be effective the firm must recognise the diversity of these factors and also consider their relative importance to the construction project.

6.3.1. Productivity of Labour Force

Construction is a people-centred and people-dominated industry whose craft processes and management practices have changed slowly (Newcombe et al, 1990). The nature of the process means that mass production techniques or even robotics are unlikely to find wide-scale applications on building site. People will be prime, and increasingly scarce, resource for construction activity for the foreseeable future (Langford et al, 1995). In such a circumstance, the productivity of labour force on site becomes an important issue.

Productivity is the rate of producing (Pilcher, 1992). Productivity is related to a country's ability to competitive with developing nations, to increase capital investments, to provide jobs and limit unemployment, and to restrict inflation and increase the 'real wage' of the worker (Adrian, 1979). Many theories have been put forward and numerous research findings have also been reported about productivity (Vroom and Deci, 1992; Eilon, 1987; Skinner, 1986). However, a satisfactory comprehensive and universal definition of productivity does not exist for construction (Pilcher, 1992). Eilon (1987:389) has defined the productivity as:

> "Productivity is a measure of how hard or effective manpower is employed to produce output."

Hillebrandt (1984:221) has defined productivity as:

> "Some measure of the output per man while efficiency is regarded as the best possible utilisation of resources under given circumstances."

Skinner (1986:56) also maintained that -

> "Productivity is mostly concerned with direct labour efficiency."

The construction industry has less than a 1% annual productivity increase (Adrian, 1979). The lack of substantial increase in construction industry productivity has come under attack from both the private and public sectors of the economy. These attacks have recently been intensified by evidence of significant increases in the cost of construction labour, material, and equipment. However, discussions concerning the increase of productivity cannot be divorced from the planning and control in terms of 'time' and 'cost'. This introduces the essential role of planning and control in the success of construction. Hillebrandt and Cannon (1990:116) have said:

> "Planning in construction should have a more important role than in many other industries."

Adrian (1981:228) has stated:

> "The management functions necessary to deliver a construction project within defined time, cost and quality objectives can all be viewed as part of two functions: Planning and Controlling."

The primary concern of the contractor in controlling his own work force is their direction and control from both operational and cost standpoints. The contractor is also concerned with controlling material and equipment usage with their costs, but usually not as intensively (Maher, 1982). The greater focus on labour is a consequence of its intangibility. It is not reusable like material and equipment. As time passes, money is owed to the labour. This debt must be paid and the staff will have to have produced something of equal or greater value in return. However, The measurement of output per man is difficult and no satisfactory means has been found of measuring efficiency, as Adrian (1979:180) has noted:

> "No single individual can manipulate more than a limited number of factors at a time as possible determinants of productivity. As such, the result is that many individual pieces of research are produced, but there is no comprehensive treatment of the overall problem."

While output per man and efficiency in the use of resources are vital data for controlling or monitoring the labour force, productivity cannot be considered in isolation from industrial relations and labour management.

The magnitude and the complexity of the work increases the possibility of industrial relations difficulties. A study of Britain in 1970-1975 revealed that the construction industry consistently suffered more strikes during the years 1970-1975. The average for those years was 50 percent above the median for all industries and services (Smith et al, 1978). Table 6.1. shows the working days lost in industrial stoppages in 1972-1990. Although the working days lost through industrial relations have changed remarkably over the period of 1972-1990, industrial relations must be handled carefully by contractor to maintain industrial peace without giving in to unreasonable demands for featherbedding, fringe benefits, and even pay raises contrary to contracts (Bonny, 1973b).

From the earnings aspect, it is interesting to find that the construction unions in the UK, have not pushed up earnings like those of other industries. Average gross weekly earnings in construction from 1976 to 1986 were lower than in other industries and services (DoE, 1987). Although unionisation is generally low in the construction industry (Buckley and Enderwick, 1989), the relationship between employers and workers is the responsibility of both. Nevertheless, the creation of a good relationship is a major management function of contractors. Langford et al (1995) indicate that the improvements in productivity obtained during a stable period of industrial relations has arisen more directly from the improvement of management methods than from technical improvements in construction methods.

An atmosphere of mutual trust and understanding has more influence on smooth labour relations than any legal system (calvert, 1986). For example, Hunt (1981) and Makin et al (1989) emphasise the importance of understanding and cooperation between management and workers and emphasise the need for cooperation between management and workers. Every manager on all levels must be able to communicate effectively. His ability to effectively communicate work tasks and company objectives to his workers dictates construction productivity.

Table 6.1. Working Days Lost through Industrial Stoppages

Year	Construction	All Industries
1972	4,188(Days)	23,923(Days)
1973	176	7,145
1974	252	14,845
1975	247	5,914
1976	570	3,509
1977	297	10,378
1978	416	9,391
1979	834	29,051
1980	281	11,965
1981	86	4,244
1982	44	5,276
1983	68	3,754
1984	334	27,135
1985	50	6,402
1986	33	1,920
1987	22	3,546
1988	17	3,702
1989	128	4,128
1990	14	1,903

Borcherding and Garner (1981) also emphasise the importance of cooperation between management and workers. Their study of twelve power plants under construction in the United States determined the effect of a number of factors on worker productivity on construction projects. Two of the projects were being constructed with non-unionised labour, while the rest used union labour. At the time of each site visit, there were an average of 1,850 craftmen employed on each project with a high of 3,600 and a low of 319. Ten were nuclear projects so the research is unrepresentative of the construction industry generally, the findings themselves are useful.

The questionnaire indicated that the motivation and productivity of craftsmen and foremen on these projects was low. Secondly, the role of the foremen was critical to productivity. Thirdly, and perhaps most important, the foremen believed that cooperation with management was vital for productivity on a construction project. Consequently, Borcherding and Garner (1981:453) concluded that although there may be many ways to improve productivity in construction, all of them relate to -

> "Providing adequate support and assistance to the workforce and establishing a cooperative atmosphere among all levels and parties involved."

This conclusion is similar to the views of Halsey and Margerison (1978), and Bresnen et al (1984). Support for this view is also demonstrated a Dutch Construction Company - Royal Volker Stevin (Arnold, 1986; Editor Staff, 1983). Stevin had serious problems with a major contract in Michigan, United States, because of its inability to complete the Zilwaukee Bridge on time. By the end of February 1981, the company had lost about £22.8 million on the contract. Needless to say that no company serious thinking of remaining in business can go on indefinitely incurring such colossal losses. The

Construction News investigation (Editor Staff, 1982:1) showed that -

> "Poor labour relations are blamed for the problem, in addition to technical problems which have caused the delay.... The Dutch company was said to be having difficulty getting enough productivity."

This simple case study illustrates the damage which a construction firm can inflict upon itself as result of its inability to honour its own side of a valid construction contract.

Other discussions reveal that a recession may be partially responsible for the decline in labour relations problems in the construction industry in Britain. Most construction managers and foremen believe that availability of many jobs during boom times, leads workers to believe that they can find another job even if they are dismissed from one. Langford et al (1995) indicate that the high unemployment experienced by the workforce in general and the building labour force in particular will have shape perceptions of the likelihood of gaining advantage through strikes. A boom in the construction industry may create labour management problems. The easier it is for construction workers to find other jobs, the greater the tendency to create problems for the construction firm. It also shows that the longer a firm is able to keep its workforce, the fewer labour problems it will face. Since most of its workers will fit into a pattern of behaviour which the firm demands of its workers.

Safety is another important factor which affects the productivity. Construction site often create potentially dangerous situations and about 100 persons are killed on them in the United Kingdom each year. Over 40,000 construction accidents were reported to HM Factory Inspectorate in 1982 (Seeley, 1986). Should an unfortunate accident happen, it will affect the morale of the workforce and cause delay. One of the principal objectives of the management is to involve everybody at the workplace - management and workpeople - to create an awareness of the importance of achieving high standards of health and safety (Fellows et al, 1991).

The European Community have adopted a series of minimum standards for health and safety at work in directories that have now been translated into UK regulations. New laws in force since 1 January 1993 oblige managers of contractors to assess and effectively control any risks to health and causes of accidents (Calvert et al, 1995).

The focus on the management of site labour force is important but the construction firm must also develop management strategies to deal with other factors such as subcontractors, suppliers, clients and their representatives, and the architects and engineers.

6.3.2. Managing Subcontractors

At one time it was commonplace for a main contractor to deal with all aspects of a large construction project. Most construction projects now use many subcontractors (NEDO, 1991). Work undertaken by firms other than the main contractor are often described as subcontractor (Ashworth, 1991). Maher (1982:182) has defined the subcontractor as:

> "The subcontractor is a construction organisation that performs specialty work or supplies specialty items."

Such subcontractors are usually specialists in particular fields, i.e., plumbing, electrical wiring, painting, masonry, etc. (Roberts, 1980). In Britain, the Committee of Associations of Specialist Engineering

Contractors (CASEC) covers heating, electrical and steel work subcontractors (NEDO, 1974). Generally speaking, the subcontractor is the specialist, and for large projects some work is subcontracted to these specialist firms. Modern industrial activity is based on specialisation and the combining of specialist skills to form an integrated whole. This fragmentation of the work is not surprising in itself because increasingly sophisticated methods of building require a high degree of specialisation. What is striking is the fact that, for the most part, these specialists do their work under contracts made not with the client but with the main contractor - known as management contracting. If these specialists do their work under a direct contract with the client, this is the system of procurement known as construction management (Murdoch and Hughes, 1992). As these firms and individuals are not in the direct employ of main contractors there is no responsibility for them over and above ensuring that they are paid for work done. Indeed this system further fragments the industry, creating more small firms and encouraging increasing levels of self-employment and casual labour (Langford et al, 1995).

While subcontracting is often viewed by main contractors as a cost-saving exercise which also permits greater flexibility than using directly employed labour, there are certain cost-increasing disadvantages caused by subcontracting: the contractor has less control in terms of standard of workmanship, output and performance generally; co-ordination is more complex and so more highly skilled management will be required; the reputation of the contractor is, to some degree, in the hands of the subcontractors and the subcontractors themselves aim to make a profit (Fellows et al, 1991).

A simple classification of subcontractors is by reference to the kind of work which they involve. At one end of the spectrum are those contracts for the supply of materials only. At the other end are 'labour only' subcontracts, in which no material of any kind is supplied (Langford, 1985). Between these two extremes lie many contracts involving the supply of both work and materials.

Usually, there are two main ways in which a subcontractor can be appointed.

1) Sub-contracting by the main contractor
2) Nomination of subcontractors

The first type of subcontractor is that selected by the main contractor without the intervention of the client or his adviser. The advantage to the main contractor is that he can choose the subcontractor he wishes - perhaps one he regularly works with - and may be able to obtain his services at a lower price than those of the nominated subcontractor. The main contractor is then entirely responsible for all operations on site, including his own work and subcontractor's work.

The second is known as nomination. The subcontractor is selected by the client through his chief designer though the subcontractor's contractual relationship is with the main contractor (Murdoch and Hughes, 1992). Client control of selection may be advantageous where the technical ability of the subcontractor or his ability to undertake detailed design work for the project is important, or where the subcontractor has a critical role in the contract. The main contractor, as before, will be entirely responsible for the satisfactory completion of the nominated subcontractor's work.

Subcontractors are a vital component of the construction process. Yet their contractual relationship with the contractor may present major control problems for the contractor during the production process. In the first place, the subcontractors are themselves independent contractors. This fact is critical in controlling subcontractor performance on the job.

Because they are independent contractors they can breach their contract at any time at their own risk. They can be held responsible for breach of contract and requested or required to make remedies accordingly. However, such remedies do not usually benefit the contractor or solve any problems which the breach may create.

One additional point is worth making since it is sometimes overlooked. A subcontractor who is in breach can expect to pay damages to the main contractor, and these damages will reflect the losses which the main contractor has suffered. As a result, if the terms of the main contract do not make the main contractor liable to the client for what has happened, then the subcontractor in turn will not be liable to the main contractor. The basic position in law is that the main contract and the subcontract (and the sub-subcontract, if there is one) are regarded as the links in a chain. Each contract is of direct legal concern only to those who are its parties.

For example, where there are defects in the subcontractor's work, the client will have a contractual remedy against the main contractor who will take action against the subcontractor. Similarly, the subcontractor's right to payment will be exercised against the main contractor who will be reimbursed by what is received from the client.

Nevertheless, subcontractors must be controlled by the contractor based on understanding and good working relationships. Working with the subcontractor, precise and detailed definition of the work which the subcontractor is to carry out and be responsible for is necessary. Baily et al (1994) suggest that particular regard should be given to the subcontractor's responsibility for making good other work, materials, equipment or access ways damaged in carry out his services. It is also important to define the subcontractor's liability for damage to persons and property. Care must be taken that the main contractor's insurance policy provides adequate cover for the subcontract operation, particularly as regards third party liability.

Maher (1982) also suggests three ways of controlling subcontractors without jeopardising their independent status:

1) Using legitimate contractual payment practices to encourage the subcontractor to follow directions and perform as requested.
2) Making the subcontractor aware of the business consequences that might result if he does not perform or is uncooperative.
3) Being reasonable and fair in dealings with the subcontractor.

Although the contractor has overall responsibility for the project all subcontractors should be treated as team members in performing their particular work. Consequently, all contractors (general contractor, subcontractors, and sub-subcontractors) involved must work together for all activities to run smoothly and efficiently. The increasing trend toward specialisation means more work is being subcontracted and this is a trend which is expected to continue. The choice of subcontractor and the management of the relationship is a key issue for clients and contractors to which the construction function has a very important contribution to make.

6.3.3. Coordination with The Client and/or His Representative

The clients with their representatives, the architect/engineer, and contractors - are responsible for their own internal management control. But because construction involves many skills and interests it needs an overall management to ensure that each of the participants coordinates their activities with those of the others to keep to schedule and budget. During the production phase, this coordinating management function is usually provided by the main contractor (NEDO, 1974). This is a difficult task and it demands intuition and creativity.

It is obvious to everyone that it is the duty of the contractor to carry out and complete the contract works. What is sometimes overlooked is that it is also the contractor's right to do this. The client and his consultants must cooperate to enable this to be achieved. It was acknowledged in Merton v. Leach (1985) that cooperation and non-hindrance are client's duty in all aspects of the contract work.

Here the major problem is that the client and his representative, the architect/engineer is the other party to the construction contract. In a standard contract, the client and architect/engineer are clearly defined within the general contract itself. Each of them has clearly defined contractual duties and responsibilities; but these clear definitions often become muddled during the contract's actual performance.

Because the client is the other party to the contract implies that the contractor has no direct control over the client and/or his representative. Yet their role is vital in the success of a project that the contractor will seek a way of exerting some influence over them. Because the contractual relationship among the contractor and the client with his representative is different from others involved, the means and methods of controlling them are different.

Nevertheless, the contractor must anticipate the thinking and behaviour of the client and/or his representative, and the effects of their actions and decisions. This may allow some degree of control or influence over them. This must be established with discretion, good sense, and respect for professional sensibilities, so that both parties can develop some working relationships, based on mutual understanding and cooperation.

6.3.4. Management of Materials and Equipment

Construction is an assembly process requiring physical inputs in the form of materials and components (Newcombe et al, 1990). The materials and components are often bulky and heavy. Materials usually account for between one-third and one-half of the cost of a building project (Fellows et al, 1991). In 1982 the total cost of materials to the construction industry added up to between £8,000 and £9,000 million. If 'do-it-yourself' sales of building materials were added the total would rise to nearly £10,000 million (The Institute of Metals, 1987). The most important bulky materials are timber, cement (including its use in partially manufactured or manufactured products), aggregates, bricks and blocks and steel. Services also use a large range of individual items in construction.

The sheer diversity of materials makes the production of construction materials a 'Big Business' and its material control system complicated. The management of materials and equipment, also involves suppliers who play an important role in providing these items. Although contractors do not concern themselves with controlling suppliers to the same extent as subcontractors there are two factors to consider (Maher, 1982):

1) The location of the supplier relative to the project.
2) The capacity of the supplier to produce and deliver on time.

However, the provision of materials and equipment is of little value if they are not effectively handled or managed. Roberts (1980:97) has stated:

> "If good material control is maintained, the entire job is under control."

Materials Management is necessary. Materials Management, a concept which has been dealt with extensively by the National Association of Purchasing Management, is described as (Webster, 1979:25):

> "Materials management includes purchasing, inventory control, traffic, receiving, and production control and has the objective of achieving the lowest overall cost of materials for the firm."

This definition recognises that each of the various functions or activities is related to others in a complex set of interactions. Materials Management relies on a 'systems' approach recognising that all functions required to produce and deliver a product are related and interdependent on one another. Undue emphasis on one function without adequate consideration of the others may lead to problems and defeat the overall objective of efficiency and cost effectiveness.

For example, inventory management costs (including costs of space, capital investment, taxes, obsolescence, and deterioration) may be excessive if the purchasing department buys large quantities to realise a low price. It is not efficient either if a fleet of vehicles bringing supplies to the site have to wait to be off-loaded. Thus, the Materials Management Concept recognises that the purchasing department's effectiveness depends on close cooperation with other parts of the organisation.

Storage of required materials is usually a problem on most construction sites. For example, large quantities of small items may be held. Other items have similar stock numbers with possible errors in receiving, issuing, reordering, and locating. All materials must be inspected to ensure that they are usable. The care and preservation of material can also involve considerable maintenance activity. All these increase management cost.

However, a well-managed storage and handling facility yields great dividends (Goldhaber et al, 1977). The principal objective of materials storage and handling is to minimise wastage and losses arising from careless handling, poor storage or theft, and to eliminate double handling or unnecessary transportation of materials and components. This largely relies on scheduling the activities so required materials arrive on site when they are actually required for specific activities or functions.

The storage facility may require space for security, for breaking down bulky shipments and for controlling supplies. In building projects, particularly in urban areas, construction sites are fenced for security and/or to comply with some local regulations. This means that the space is limited and must be managed to accommodate all material and still provide space for the movement of site plant or equipment, and the workforce. A badly managed site may create materials wastage, discomfort for the workforce, and low productivity. Calvert (1986) has described how a site layout plan should be prepared showing the proposed locations of all facilities, accommodation and plant to secure optimum economy, efficiency and safety during construction. A tidy site is the outward symbol of an efficient contractor.

Plant management may be another problem. In the past large numbers of people were used to achieve remarkable feats of building, today the shortage of people has led to the development of sophisticated plant to carry out the heaviest tasks (Newcombe et al, 1990). Plant plays an increasingly important role in building as well as civil engineering operations, and both time and money can be saved by the efficient use of mechanical aids (Calvert et al, 1995).

Generally a construction company has two options in acquiring plant: it may either own its machinery and equipment or hire it. There has been a recent trend toward hiring equipment for both long and short periods. The growth of the independent plant hire sector of the construction industry has greatly facilitated the hiring option and approximately 50-60% of plant presently used on projects is hired (Harris and McCaffer, 1989).

Hiring has been described as a means of making a profit with the capital of others (Robinson, 1973). There are several advantages to the contractor of hiring equipment. They can obtain it from a source near the site. The contractor is not concerned with maintenance problems or the dislocations associated with breakdowns. If it is hired with an operator he even obtains a competent operator. Plant hire has increased the ability of small contractors to compete with large ones (Hillebrandt, 1984).

Machines are able to achieve previously unattainable levels of production, but at cost. Hired plant and equipment is usually costed in hours. Hired plant is wasted if kept when they are not really needed. Therefore, before hiring important equipment, a careful comparative-cost study must be undertaken (Rubey and Milner, 1966), and when, where, and how the hired plant and/or equipment is to be used must be determined (Maher, 1982). Usually hired plant should be kept on site for as short a period as possible.

All industrial situations are somewhat different and the application of materials management varies within industries, but effective management of the materials and equipment is essential in the construction industry. Contractors with successful materials management practicing realises such satisfactory results as reduced materials cost, effective inventory control, better labour utilisation, and improved organisational efficiency and flexibility. These benefits directly influence the construction operations in the commitment stage.

6.4. RESOURCE MANAGEMENT IN CONSTRUCTION

As we have discussed in the preceding section, many resources are needed to complete the construction stage of a project. These include people, equipment, materials, and subcontractors (Oberlender, 1993). Each must be managed in the most efficient manner to keep costs to a minimum and to achieve better productivity during construction.

The craftsmen that install material and operate equipment are the most important resource in construction. These individuals gain their skills through training and experience. They have the ability to accomplish the work. Too often, the workers are criticised for not producing good work on a project. The greatest difficulties arise when we try to manage human beings because humans do not behave in a regimented or mechanistic manner (Langford et al, 1995). The major resource input to construction is human and it is therefore important for the industry to integrate the Human Resources Management (HRM) into the total management of the firm. However, human resources management has traditionally been undervalued and therefore underdeveloped in the construction industry. This situation becomes a major source of risk. Langford et al (1995) identify a number of constraints as responsible for this situation:

* the relatively high cost of HRM when most contractors are small

* the fragmented nature of the industry
* mobility of the workforce
* the shallow management structure generally found at the project/site level
* subcontracting and the use of casual labour
* the attitudes and education of construction managers from a trades background

Gale (1991 & 1993) indicates that the workforce is ageing, there are an increasing number of women available for work in construction, and there is a greater proportion of female students in built environment subjects at universities than at polytechnics. Architecture, building services engineering and building surveying have shown increases in female undergraduates. Demographic changes which the UK is facing has affected the nature and size of the available workforce in construction (Sloan, 1991), also affected human resources management (Langford et al, 1995). Construction companies need to undertake appraisals of the effects of demographic changes and must be aware of general trends that have the potential to affect the labour force.

Changes in the economic environment have also led to changes in working patterns. This is noted in the rise of subcontracting. Much of the work required on many construction projects is performed by numerous subcontractors who work for the main contractor. This multiple contract arrangement requires careful planning, scheduling, and coordinating by the main contractor to integrate the work of all subcontractors on the job. The employment of subcontractors reduces the wage and overhead bills of main contractors during lean times enabling them to remain in business and competitive, but also has detrimental effects on the level of training. Large contractors with no directly employed labour force have no reason to provide training. If subcontractors are employing people on a casual basis, they will argue that responsibility for training lies with the individual. Whatever the logic, an untrained workforce will produce poorer quality work and is prone to accident than a trained one. Untrained workforce is a risk factor and therefore contractors must consider the training courses for personnel.

Equipment and materials are other two important resources in the construction industry. The type and number of equipment used on a project depends on the nature and the size of the project. The selection and utilisation of equipment on a project must be an integral part of the total construction plan and schedule, just as there must be a plan for the workers on the project. It is the responsibility of the construction/project manager to develop an equipment plan for the project.

A major cost of many construction projects is the acquisition and installation of materials. A materials management system includes the major functions of identifying, acquiring, storing, distributing, and disposing of materials needed in a construction project as we have discussed in the preceding section. The effective utilisation of people can be greatly enhanced by ensuring that quality materials are available when and where required. A material plan will vary depending on the project size, location, cash flow requirements, and the procedure for purchasing and inspection. It is the responsibility of the contractor to ensure that a well-defined materials management system and materials management plan is developed for the project.

Resources management becomes more and more important in the construction industry. In the future human resources management will assume a greater importance because so much construction work is labour-intensive and manpower costs are high in relation to total costs (Langford et al, 1995). Therefore, an increase in the employment of human resources managers and tools in the construction industry is necessary for an effective management of construction work. An inability to manage human resources will become a major source of risk.

Based on discussions and findings, we hypothesised that -

H4: The successful execution of the construction work largely depends on the contractor's resources and management ability. Hence 'Management Risk' is the main risk in the contract commitment stage.

Hypothesis H4 can be expanded as follows:

H4a: Coordination with the client is vital for success. Poor coordination is positively correlated with risk.

H4b: The contractor's ability to manage labour and subcontractors is important in reducing risk.

H4c: The contractor's ability to manage materials and plant is important for managing risks.

6.5. RISK IMPLICATIONS IN MARKETING

Because most construction products are sold before they are produced, both the buyer and the seller are dealing with a hypothetical or an abstract product. The main risk in the commitment stage in industrial marketing relates to client/user's post-purchase satisfaction and source credibility. The client's post-purchase satisfaction is related to two factors:

1) The performance of the contractor on the contract, in terms of delivery on time and budget, and
2) The performance of the product after it has been delivered. In other words, the quality of the completed project.

Contractor's performance is normally assured by the client's requirement that they provide a performance bond. This serves as insurance against the contractor's failure to perform. The performance bond, normally issued by insurance companies specialising in this business, tends to emphasise the financial standing of the contractor rather than its performance (The Aqua Group, 1986a). The bond-issuer undertakes to 'make good any damages suffered by the client' as a result of the contractor's inability to perform, and assures themselves that the contractor has the capacity to perform.

Product performance after delivery, is also assured by client's inclusion of a retention clause in the contract. This allows the client to retain a certain percentage of the projects value. The retained money may be used 'to make good' any unsatisfactory performance of the product during a specified period after it's completion. If the performance of the product has been satisfactory during the specified period, then the money is released to the contractor. Overall, clients seek value for money through good performance and its assurance.

The commitment stage is a test of the contractor's ability to forecast their performance and assess the factors which affect its performance. The commitment stage is also an opportunity for the company to market itself to help the client achieve satisfaction. It helps increase their credibility in two ways:

1) Through the delivery of the product on time; and
2) Through the quality of the delivered product.

Time and cost are inextricably linked in any construction contract. A delayed project benefits neither the contractor nor the client. It could in fact be disastrous for the contractor, though this depends on the circumstances. The contractor must recognise this, and also use the delivery date as a marketing tool. The delivery date is usually set during the tendering stage but it will be of no use if it is not achieved. The early delivery of the actual product is what matters more than on the contract, though this affects the client's purchase decision. On time completion will not only bring the direct rewards of reduced costs and higher profits but will also help attract additional business from satisfied clients and provide a track record useful for marketing.

In the construction industry technical expertise is often an important influence on credibility (Webster, 1979). The contractor can also use the quality of the finished product as a marketing tool. The client would take 'quality' as a given variable (Adrian, 1979), since the client's architect/engineer will see that the project is constructed according to specifications.

There may be a significant difference between an 'excellent' product and an 'acceptable' one. The client of a construction project may not have any basis to reject a project which is 'acceptable', but which could have been better. In such cases, the client would not normally have future dealings with the contractor. The reputation of the contractor is affected by providing a minimal level, rather than complete, satisfaction.

In recent years, considerable attention has been given to the Total Quality Management (TQM) concept that emphasises teamwork at all levels of an organisation to improve the quality of a project and achieve maximum customer satisfaction (Oberlender, 1993; Hellard, 1991; Burati, 1990; Deming, 1986). As in construction industry, TQM is a management philosophy that effectively determines the needs of the client and provides the framework, environment, and culture for meeting them at the lowest possible cost. By ensuring quality at each stage in the construction process, from conception through completion, the quality of the final product will in turn satisfy the client.

The commitment stage provides the contractor with the opportunity to impress the client with a high quality product, delivered on time and budget. However, the effective use of both 'delivery date' and 'product quality' as marketing tools must be based on the overall management of all the factors which may make this possible. Finally, the reputation of the contractor is judged on each project undertaken. The contractor is presumed to succeed every time and should make every effort to deliver on time and to specification. One 'bad' project can damage a reputation which has taken years to create.

Efficient and effective marketing is vital for success. Usually, analyses have concentrated on technical aspects - time of delivery, quality and price. However, Langford et al (1995) indicate that the traditional '4Ps' transaction marketing (product, price, promotion and place) is now unappropriate for contractors. Increasingly this will move towards 'relationship marketing', where the main determinant of client satisfaction will be expressive performance, i.e. the perception of how the service is provided. Relationship marketing will be the key to success in obtaining work (Fellows and Langford, 1993). All contractor's personnel must be part-time marketers where long term, integrated relationships are sought. The relationships establish trust, repeat orders and stability - a well-known recipe for success. However some contractors argued that the creation of such relationships were unhealthy because they eliminated competition (Fellows and Langford, 1993).

6.6. CONCLUSION

This chapter has broadly discussed the advantages of a standard forms of construction contract, risk implications of non-standard forms, factors affecting a successful completion of a construction product in construction process and its industrial marketing risk implications. Based on our discussion, we can draw the following conclusions.

Construction contracts are required to formalise the complex arrangements and relationships that are likely to encountered in the construction projects. Although the client usually determines how construction activities are to be handled and what forms of contract are to be chosen in the execution of the contracts, we must remember, there are numerous clauses and conditions negotiable and this leaves the contractor the opportunity to negotiate with the client for reducing risks imposed.

The execution of a project is the most complex and difficult task. It involves many inputs and factors with many sources of risk. There are a wide range of management problems to be solved. Supervision of the workforce, especially on site, is the major problem in most construction projects. In addition to effective management of the human resources is essential this cannot be achieved without effective materials and equipment management.

The success of the commitment stage depends, to a large extent, on the contractor's ability to manage all the factors involved. An inability to manage becomes a major source of risk. Contractors must develop and use risk management strategies in this stage to meet their objectives.

CHAPTER SEVEN: METHODOLOGY OF THE STUDY

7.1. INTRODUCTION

This chapter will describe the methodology used by this study, the problems encountered and the survey results. The points discussed are the studies:

* Definition and scope
* Conceptualisation and design of the research
* Choice of research methods
* Sampling design
* Questionnaire design
* Piloting the questionnaire
* Selection of the respondent
* Data processing and analysis techniques
* Problems encountered

7.2. DEFINITION AND SCOPE

The choice of the industry to study was based on four main criteria. First, the industry had to be important in its association with the public sector because of the author's own 'government official' background. Second, the industry must be important in terms of its contribution to the general development of the country. This criterion was particularly significant in providing insight on the economic development of Taiwan, the original subject considered. The third criterion is that contracting must be used widely in the industry. The fourth is the industry must be accessible.

After a careful consideration of several industries, the construction industry was found to satisfy all the criteria.

Defining the 'Construction Industry' is not a simple task, and different writers have used the term according to their needs and aims. In the words of Robinson (1939) the industry is usually subdivided into 'Building' and 'Public Works Contracting' industries, and the term 'Construction' can be used to refer to both two industries.

This is also the view of the Institute of Marketing (1974) and the Central Statistical Office (CSO, 1981) that the construction industry is made up of two basic parts - the building industry and the civil engineering industry. Although the distinction between the two industries has been made, it is clear that there is no definite dividing line between the two parts.

Chapter Three showed that the definition of the construction industry varies from situation to situation. On the basis of this practical difficulty of separating the two parts, the term 'Construction Industry' used in this work refers to both the 'Building Industry' and the 'Civil Engineering Industry' in the United Kingdom.

However, the terms 'United Kingdom' (UK) and 'Great Britain' (GB) were seen in different published statistics and reference sources and confused the author at the beginning of this study. These two terms need to be defined clearly so that the scope to the study becomes clearer.

Readers as 'outsiders' like the author are reminded that the term 'United Kingdom' (UK) includes Northern Ireland, whereas 'Great Britain' (GB) does not (Anderson, 1989). Consequently, this study included the construction companies operating in the United Kingdom (UK).

7.3. CONCEPTUALISATION AND DESIGN OF THE RESEARCH

The central proposition on which the study is founded is that decision making may be viewed as a risk taking activity. Adopting this viewpoint gives rise to a simple risk model. Certain factors may be expected to influence the level of risk perceived in a course of contract decision action. As a result, the preferred course of action may be assumed to be that which most successfully reduces the level of perceived risk.

The words 'risk management in dealing with contracts' used in the research topic produced the basic conceptualisation of the study. This work was conceptualised as studying perception and management of risk by construction companies in the phases through which the contract decision evolves. This conceptualisation guided the design of the research, and helped focus in a number of related and broadly based hypotheses about the perception and management of risk by construction companies. Specifically, it is centred on the following hypotheses:

H1: Construction companies perceive risks in their contracting process, however the level of perceived risk is determined by situational factors.

H2: Rigorous risk analysis techniques are not widely applied in the contracting process of the construction industry, instead the more traditional techniques are still favoured for risk analysis.

H3: The tendering stage is the most important phase for applying risk management primarily through an effective bidding/negotiating approach.

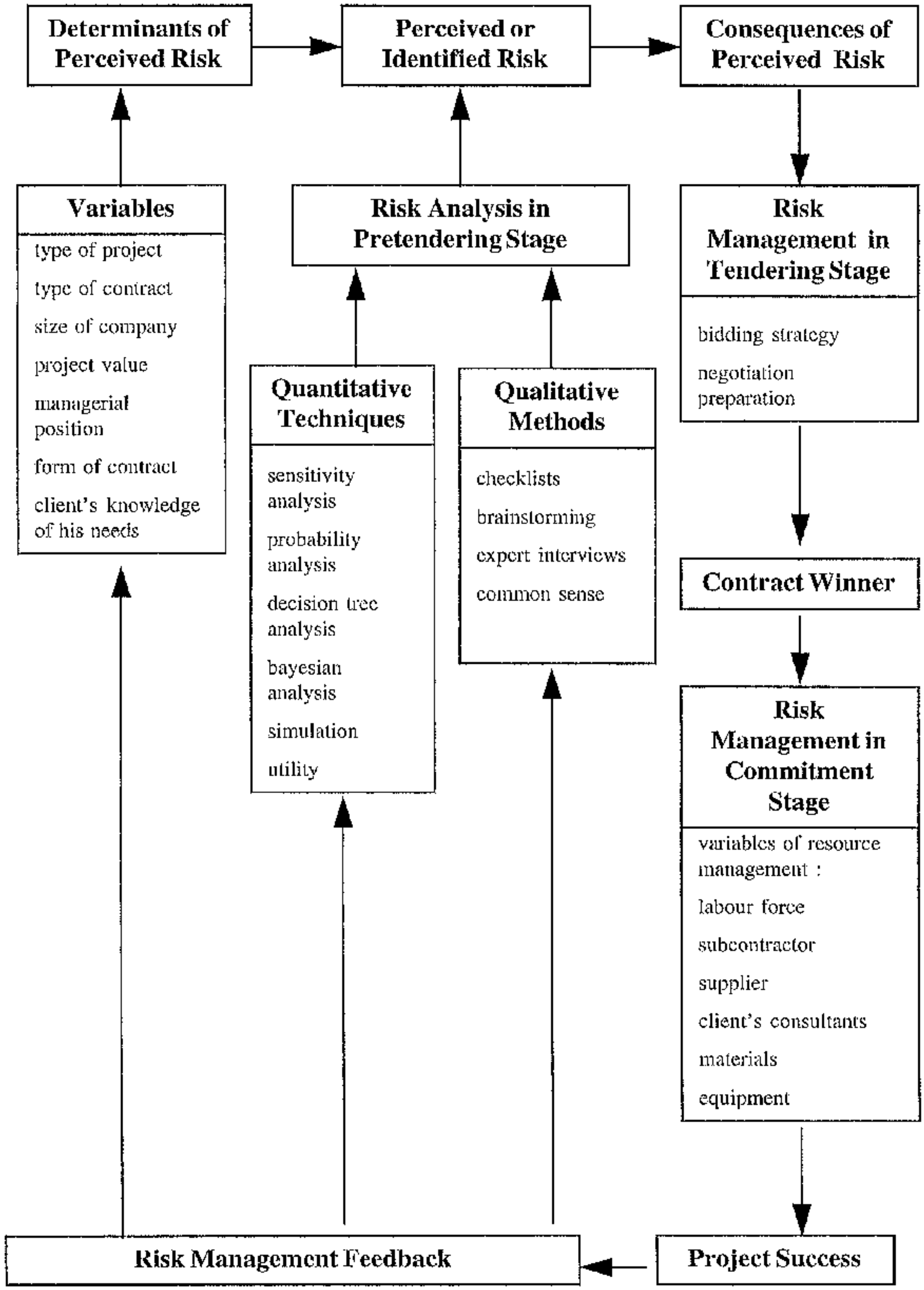
H4: The successful execution of the construction work largely depends on the contractor's resources and management ability. Hence 'Management Risk' is the main risk in the contract commitment stage.

The study will not focus on any one particular stage, but will consider all the phases through which a construction contract decision process evolves. Although the tendering phase is very important a broader perspective was justified on the grounds that a contract is not considered successfully concluded until the project is completed, or delivered. This has been demonstrated in the preceding chapters. A narrow focus on some of the phases would not provide the overall picture of how construction companies perceive and manage risks during a project. The model used to drive the research is shown in Figure 7.1.

The model building process begins by looking at the left hand side of the risk equation in an attempt to identify the determinants of perceived risk in contracting process. The major independent variables identified in this model included: (a) type of project, (b) type of contract, (c) size of company, (d) project value, (e) managerial position, (f) form of contract, (g) client's knowledge of his needs, (h) methods of risk analysis, (i) methods of contract procurement, (j) characteristics of negotiation team, (k) coordination with clients, (l) labour management, and (m) materials management. The major dependent variables included: (a) perceived risk, (b)the manner in which risk analysis were adopted, (c) winning the bid, and (d) contract success. The model not only provides a conceptual and analytical framework but more importantly may be applied to derive realistic, actionable management policies in managing risk.

The study is based on completed construction contracts. The data collected deals with how contract decisions had been made rather than how they will be made. There could be problems with the respondent's recall, whether the respondents would remember accurately what actually happened when the decisions were being made. This raises the issue of how far back should the study go, in view of the suspicion about the reliability and validity of the respondent's recall on decisions taken long ago.

Figure 7.1 Simple Risk-Based Research Model



An alternative could have been adopted by requesting the respondents to base their answers on any ongoing contracts. However, while this may have eliminated the problem of producing a modified form of information, it would have made it difficult for the respondents to answer all the questions since this study looked at all the phases through which a construction contract evolves. This particular problem is amplified by the fact that most construction projects take a relatively long time to complete.

A compromise solution was found. Each of the construction companies in the sample was requested to base all its answers on any one contract it completed in 1991-1993. Although the problem of hindsight may not have been eliminated completely in this way, it was hoped that, the research methodology would be able to overcome the main problem of respondent's inability to recall accurately decisions taken in the past and satisfy the requirement of 'timeliness' of information supplied.

7.4. CHOICE OF RESEARCH METHODS

There were different research techniques available for this study and a number of them were considered. No attempt is made here to describe the characteristics of each method, since an extensive literature on this subject is available. Three particularly considered research alternatives are discussed here. They are:

* A personal interview method to collect the required data from the respondents;
* A longitudinal approach to collect the required data over time as contracting phases evolve;
* A cross-sectional approach to collect the required data through a structured postal questionnaire.

Each of the techniques has advantages and disadvantages. All were considered very carefully before the final choice was made. The final choice of research techniques is not only dependent on the author's restricted personal conditions, and it also reflects the author's perception of the problem surrounding the study.

7.4.1. The Personal Interview Method

Personal interviewing is a two-way purposeful communication initiated by an interviewer to obtain information relevant to their research. Use of personal interviews generally enables the researcher to obtain detailed information from the interviewee.

The researcher can ask the respondent to elaborate on some answers which may not be clear to him, or provide supplementary information on particular points, or both. The reaction of the respondent to each question can also be observed so that questions which may be misunderstood can be explained by the researcher. Moreover, the personal interview results in a higher response rate than the mail questionnaire (Frankfort-Nachmias, 1992). Answers from respondents who would not ordinarily reply to a mail questionnaire can easily be obtained in an interview.

In spite of these advantages which make this technique attractive, there are also a number of difficulties with it.

First, the personal interview introduces the possibility of 'bias'. The flexibility that is the interview's chief advantage also allows the interviewer's personal influence and bias to affect the results. Interviewers may give cues that influence respondents' answers, although they are instructed to remain objective and to avoid communicating personal views (Williamson et al, 1977). Sometimes the interviewer's race or gender could lead to uncooperative behaviour on the part of the respondents (Frankfort-Nachmias, 1992).

Second, using personal interviews as a research technique requires substantial time and resources to administer. Costs are particularly high if the sample to be interviewed is large and scattered over a large or wide geographic area (Emory, 1980). As was the case in this study.

Third, especially when the author himself has a language barrier, understanding issues studied from an interviewee's point of view can be extremely difficult.

These disadvantages were particularly strung in this study. Hence the interview method was not used for the research. Nevertheless, interviews on a limited scale were adopted for pilot study and follow-up study providing in-depth insights into the questionnaire design and the application of the risk analysis techniques respectively.

7.4.2. The Longitudinal Approach

When a researcher uses a longitudinal approach, he can establish himself in a single case, collect the data and write up the results by observing behaviour over a long period. The main advantage of the longitudinal approach is its more effectively link between cause and effect. The longitudinal approach makes it possible to study the observed phenomena as they occur in their nature settings. Moreover, the element of human error can be reduced considerably in comparison with some other data-collecting techniques, for instance, postal survey (Clover and Balsley, 1974). Also measuring, testing and recording devices can be used in many situations to secure more accurate data.

However, adoption of a longitudinal approach would have created the following two major problems.

First, a longitudinal approach requires considerable amount of time and effort in securing initial cooperation of the management. Usually, numerous meetings are required to gain access and the researcher's purpose has to be explained to different levels of management.

Second, it requires considerable commitment from the cooperating managers. When the researcher is not present to observe decisions and events the managers record the events as they occur.

The amount of data which could be collected through a diary approach would depend not only on the willingness and enthusiasm of the managers but also on the nature of the information recorded. This data would be limited since a diary is only suitable for information which could be recorded easily at the time the activity is being monitored. The practicalities of undertaking diary research are fully discussed in Bowey and Thorpe (1986). A number of other efforts using diaries are listed below:

* Managers participated need to be able to express themselves well in writing.
* Instruction and systematic structure is necessary to give the diarist focus during the study.
* Continued encouragement all the time.

A longitudinal approach was not adopted because of the major demands on time, commitment and resources it required.

7.4.3. The Mail Questionnaire

The use of structured mail questionnaire was the third and last alternative this research considered. However, in doing so, the author was also fully aware of the following disadvantages.

First, the problem of questionnaire length. Howard and Sharp (1983) suggested that it would usually be unwise to have a questionnaire take more than fifteen minutes to fill in, or covering more than ten pages. However, a questionnaire detailed enough to obtain the required information on decision making about the perception and management of risk would require more time to complete. As a result, the response rate might be low, creating a problem of sample representativeness.

Second, it was also recognised that the researcher has no or little control over the respondent; hence they cannot be sure that the appropriate person completes the questionnaire. The respondent is most likely to go through the questionnaire first, study it, and then decide their responses.

Third, the answers to the questionnaire have to be accepted as final. There is no opportunity to probe beyond the answer, to clarify ambiguous answers, or to appraise the nonverbal behaviour of respondents.

In spite of these disadvantages the mail questionnaire is a widely used research technique. It has major advantages to compensate. Economy is one of its most obvious appeals. It takes less time to administer, and is relatively less expensive than other research methods. Unlike the personal interview method, a mail questionnaire reduces the 'biasing errors' due to cultural and/or racial differences between the researcher and the respondent. A mail questionnaire is also preferable when questions demand a considered (rather than an immediate) answer or if answers require consulting files, personal documents or other people. Another advantage in using mail questionnaire is that respondents who might otherwise be inaccessible could be contacted . Persons such as directors, chief executives, and managers are difficult to reach in any other way.

These advantages suited very much the conditions surrounding this study. For example, the language problem, the sample companies were scattered all over the United Kingdom, and the resources and time required to use of any of the other techniques were not available, even for a 'small scale' effort. The mail questionnaire was the most suitable technique to use to collect the required data.

7.5. SAMPLING DESIGN

This study is concerned with 'sellers' - construction companies, as opposed to 'buyers' - construction clients or customers.

Although the population of construction companies operating in the United Kingdom is not infinite, the number of construction companies operating in the United Kingdom is difficult to determine or establish. This is because of the ease with which companies can enter and leave the industry. Bankruptcy and other reasons, such as diversification, merger and acquisition, renders records on the number of companies operating inaccurate.

In spite of these shortcoming two sources were used as sampling frames. The concept of a sampling frame is closely related to defining a population. It is a list of candidates from which the sample is actually drawn (Emory, 1980). The first source was *Kompass* (1993/1994) which provided the names, addresses and the technical capability of the companies. The second source was Dun and Bradstreet's Guide to *Key British Enterprises* (1993) which also provided company names, addresses and the names of the Chairmen, Managing Directors, and Managers. This source also provided information on annual sales of the companies. However, as a practical matter, the sampling frames used in the study still differ from the real population.

Given the time and resources limits it was impossible to adopt a full survey of all companies. Sampling was needed. Better use of time and resources was not the only benefit of sampling. Deming (1990) argues that the quality of a study is often better with sampling than with a complete inspection. Sampling also provides results more quickly than does a full survey.

However, the use of the sampling frames did not simplify the determining of the size of the sample. There had been no previous study which would have indicated how the respondents would react to a detailed questionnaire. A rough idea of response rates came from a pilot survey that was rather limited in scope. The sample and its size was determined on the basis of the following criteria.

First, the small companies were excluded from the sample. Although a good sample design must represent the various characteristics of the population of companies in such a way that the responses from the sample would be a fair representation of all the companies in the population, the results of the pilot showed that small companies most likely not to response, thus biasing the overall response towards a more positive picture if they are included in the sample. There are no statistical solutions to this problem other than increasing the overall sample to provide a greater margin of safety. Also a main concern of this study is the application of risk analysis techniques in the construction industry. It was thus felt that larger companies were in the better position to provide most useful information in this aspect.

The first criterion was therefore introduced. It was that the 'small' companies - the turnover not above £2.8M (Kompass 1993/1994) - would not be included in the sample.

The second criterion used in the sampling design was the speculative/non-speculative sector of the industry. The 'speculative sector' of the construction industry is defined as the sector which develops properties to be sold at their own cost. This means that construction companies which operate in the speculative sector of the industry were not included. The sample consisted mainly of companies operating in the competitive bidding sector of the construction industry.

Third, the sample size must be large enough to yield a response from at least fifty (50) of the sample companies. Since a small sample would not yield enough data for valid or reliable analysis. This is a questionnaire distributed by mail to sample companies it could be unreasonable to expect a response rate of more than 50% like that of the pilot survey. Thus in order to ensure that an adequate number of questionnaire are returned for analysis, the number dispatched would need to be doubled, at least.

After applying these criteria, a sample of two hundred and ten (210) companies was identified. They are almost two-thirds of all the medium and large companies in the UK. The sampling method applied in the study may be termed a combination of both 'purposive' - excluding small companies and those operate in speculative sector, and 'random' one - the rest has an equal chance of being included in the sample.

7.6. QUESTIONNAIRE DESIGN

The foundation of all questionnaires is the question. The questionnaire must translate the research objectives into specific questions so that their answers will provide the necessary data for hypothesis testing. Ferber and Verdoorn (1970:213) have noted that -

> "The questions must be clear, simple and to the point. They must be well organised, at least from the point of view of the respondent, ... This is especially true of a mail questionnaire, which essentially has to speak for itself."

This study's focus on the perception and management of risk by construction companies during the phases in contract decision making involved question posed about each stage. The questionnaire were designed to take account of the following four critical decision phases:

1) Pre-tendering stage
2) Tendering stage
3) Negotiation stage
4) Contract commitment stage

All questions were developed within this framework to address the hypotheses. However, some of the questions were designed to provide relevant information which would allow some conclusions to be made about certain aspects without necessarily involving the use of sophisticated statistical analysis.

Questionnaire design was not easy. It took time to complete the questionnaire. Variables needed to be carefully identified, questions without objectives needed to be eliminated, and identifying how these questions could have been satisfactorily answered needed to be considered in detail. Nevertheless, most questions were designed to solicit information about the behaviour of each company in terms of its perception and management of risk in each of the phases identified.

To increase the respondent's interest and motivate them to answer the questionnaire, several points were addressed in designing the questionnaire.

First, the questions followed a clear and smoothly-moving sequence to allow the respondent to get through them more easily. The questions that were easiest were placed near the beginning. For example, the first few questions were just about the nature of the company, the client, and the type of contract and its value.

Second, an abstract was provided. This briefly and clearly described the purpose of the research and the objectives of the questionnaire. This, the author believed, would make the respondent feel confident in answering the questions because he could understand the general scope of the questions in advance.

Third, except for a few questions which needed the respondent's personal view, most questions were designed as closed-ended. Closed-ended questions are easier to answer than are open ended ones.

Finally, after the questionnaire had been constructed, an explanatory cover letter was written. It identified the sponsor of the study, explained its purpose, and assured that all responses would be kept confidential and the respondent would be supplied with copies of any interim and final reports (See appendix A). This is of particular importance in postal surveys, especially when one needs to ask more than a few simple questions and secure a high response rate.

The questionnaire was successful and seemed acceptable to most respondents. One respondent commented that the format of the questionnaire was much better than many he had received.

7.7. PILOTING THE QUESTIONNAIRE

It is standard procedure in surveys to test a questionnaire before it is used. Many difficulties may be detected at this stage including ambiguities in the questions, a failure of questions to be understood by respondents, and a failure of the questions to fit all respondents in their situations as they perceive them (Lansing and Morgan, 1971).

In piloting the questionnaire, the author had selected a number of companies in Glasgow and Edinburgh. The selected companies were approached to seek their agreement to a personal visit. Some companies allow a visit and interviews to collect information from appropriate managers. Others were willing to help by filling out the questionnaire and asked for it to be mailed to them. Some declined for practical or policy reasons.

A number of discussions with selected companies tookplace. The questionnaire was mailed to others. In both cases the respondent was requested to review questionnaire carefully, and then give his candid view on:

1) Were any particular questions difficult to understand?
2) If the questionnaire were sent by mail, would they be prepared to answer the questions?

Negative responses were followed up by seeking explanations for the refusal. Modifications were made to the original draft in line with the comments and suggestions made by the respondents, most of whom were personally interviewed. This pilot was designed to ensure that the questionnaire achieved two main objectives:

First, to ensure that the questions were not ambiguous or difficult to understand.

Second, to ensure that the final questionnaire would give a meaningful response.

The response rate to the pilot survey was more than fifty percent (55%). In spite of the encouraging response rate to the pilot, it was suspected that a postal survey with a relatively long questionnaire (eighteen pages, see appendix B) might lead to a low response, though research evidence did not support this view (Kanuk and Berenson, 1975).

Two alternatives were considered. The first was to minimise the possibility of a low response rate by reducing the length of the questionnaire, and excluding some of the issues it dealt with. This would have meant a high response rate at the expense of insufficient data on the issues the research was to cover.

The second alternative was to leave the questionnaire unchanged on the understanding that, although the response rate might be relatively low, this could be compensated for by the relative 'richness' or adequacy of the data generated. Most respondents to the pilot indicated that their refusal to answer the questions had nothing to do with the questionnaire length. The second alternative, not to change the length was considered to be most appropriate for this study. It was adopted and the sample was fixed finally at two hundred and ten (210) construction companies. This large sample would reduce the possibility of unrepresentativeness in the sample.

7.8. SELECTION OF THE RESPONDENT

When information is to be collected about the company as a unit, there is a choice as to who will be designated as the respondent. Problems of selecting respondents in business enterprises are not easily reduced to precise rules. Different organisations have different internal divisions and sets of titles for jobs. There may also be problems about who is willing to respond. One cannot always go to the top.

However, only one questionnaire was sent directly to the Managing Director of each companies with a request that he complete it or direct it to the 'appropriate project manager' to answer the questions. Since the 'contract decision making centre' of a construction company would most probably be made up of a number of top company officials, such as Managing Director or the Chief Executive, Contract Manager, Construction Manager, and the Chief Estimator, so this was appropriate.

Previous research (Lansing and Morgan, 1971) showed that the information provided by one questionnaire is sufficient if the topic was consistently understood by the managers in the company. In this case the cost of producing and posting the extra copies of the questionnaire cannot be justified. There were practical difficulties since where more than one questionnaire is sent to each company, most are likely to return only one questionnaire.

7.9. DATA PROCESSING AND ANALYSIS TECHNIQUES

The processing and analysis of the data has been undertaken using a computer. This allowed a grouping of the answers from the questionnaires into contingency tables, which then facilitated further analysis.

7.9.1. Data Processing

Data processing linked between data collection with its analysis. Observations were transformed into coded responses then subjected to quantitative analysis. The coding process consists of assigning numbers to answers to enable the responses to be grouped into classes or categories.

The questionnaire finally mailed out was designed to be highly structured with closed-ended questions. This design should have eased the coding process and subsequent analysis. However, some open ended questions were included in the questionnaire and these made the coding and analysis of data a time consuming and challenging task.

The tabulation and the statistical analysis of the data were done on a personal computer (PC) using the MINITAB statistical package. MINITAB is a user-friendly, fully interactive and easy to use package (Ryan et al, 1985). Some of the data, particularly from the open ended questions has been handled manually.

7.9.2. Selection of Statistical Techniques

The statistical techniques used to analyse the data depended on the nature of the data, and the question that generated it. In general, data analysis has been accomplished in the following ways:

1) Where the variables involved could be assumed to be continuous and have interval properties, then an analysis of variance was produced.
2) However, where these assumptions cannot be made, a cross-tabulation was produced to examine the relationships between the dependent and independent variables.

Most variables in the study could be measured only on nominal or ordinal scales so that sophisticated techniques of analysis could not be applied. Both these scales of measurement limit us to nonparametric or 'distribution-free' statistics, because we cannot make any assumptions about the parameters or dimensions of the underlying population. Besides having the advantage that normality is not assumed, nonparametric statistics is easier to carry out because the computations are simple. Usually it uses some simple feature of the sample data, such as categoric frequency, differences between pairs, or order relationships, and so do not require metric data.

The analytical techniques used in the study are descriptive statistics, percentages, contingency tables, and chi-square tests. For the purpose of establishing the relationships between dependent and independent variables and describing the strength and direction of the relationships, the chi-square test and the correlation coefficient have been used where suitable.

The chi-square test is often applied to problems in which two nominal variables are cross-classified in a bivariate table (Frankfort-Nachmias, 1992). There are limitations on using the chi-square test of independence. The principal problems associated with chi-square test arise from the sample size. Ryan et al (1985:274) suggest that -

> "A good rule of thumb is that not more than 20% of the cells should have expected cell frequencies less than 5, and no cell should have an expected frequency less than 1."

Rees (1985:125) also maintains that -

> "The formula for calculated chi-square test is theoretically valid only if all the E values are sufficiently large, and E >= 5 is the accepted condition to apply."

Bartlett (1975) also comments on the validity of chi-square test where all the expected values are equal to four. Lewontin and Felsenstein (1965:31) gave a rule for tables where r=2.

> "The 2xN table can be tested by the conventional chi-square criterion if all the expectations are 1 or greater."

Thus, there is no hard rule for the minimum expected cell frequency acceptable in a chi-square test. Although it appears that the standard rule of thumb of 'no cell less than 5' is over conservative, the method of collapsing contingency tables was carried out in the data analysis in this study when expected cell frequencies were low.

Also the suitability of the data is important if the correlation analysis is to produce worthwhile results. Frankfort-Nachmias (1992:399) for example, has maintained that -

"Pearson's product-moment correlation coefficient or Pearson's *r*, is an interval measure of relationship."

Nie et al (1975:280) have stated that -

"The Pearson correlation coefficient *r* is used to measure the strength of relationship between two interval-level variables."

They also indicate that the Spearman and Kendall rank-order correlation coefficients require rankings, rather than absolute values. Theodore (1982:343) has the same view that -

"Calculation of Spearman rank correlation coefficient r_s is based on the ranks of the values of the two variables."

The chief difference between Spearman's r_s and Kendall's tau are that the Kendall coefficients are more meaningful when the data contain a large number of tied ranks. With many ties, Frankfort-Nachmias (1992) indicates that Kendall's tau-b can be used to handle the problem of ties. In general, when many observations are concentrated in few categories, there will be many tied pairs. Because the questionnaire included a relatively small number of categories Kendall's correlation coefficient is preferred to Spearman's.

However, in some cases, conclusions are based on the contingency tables, where the results may not be meaningfully improved by further use of statistical techniques because of the size of the sample, the small expected counts in each category and when the data is discrete.

7.10. PROBLEMS ENCOUNTERED

A number of problems were encountered during the field investigation and data processing. They may be summarised as follows:

Access

Obtaining permission and getting access to companies or interviews for the pilot study was a time consuming and frustrating process. Once permission was granted, the arrangement of an interview was not easy. Some interviewees were pre-occupied with their duties and could not afford much time. Others would not be available for long periods for personal and professional reasons (Pilot study was held in July and August - holiday season).

Editing

Some questions in the questionnaire were open ended. Most replies were hand written in illegible (personal view) and individualistic writing styles. The illegible responses were deciphered and rewritten with difficulty.

Confidentiality

Because the study considered project contractual arrangements (more accurate saying - contracting phases), some respondents did not understand the purpose of the study or the fact that their responses would be kept confidential. Some did not complete the questionnaire and explained that their company's policy was not to reveal any contract information.

7.11. CONCLUSION

This chapter has discussed the choice of the construction industry as the subject of the study, as well as the research design, and its conceptualisation. The choice of mail questionnaire as research technique was explained and the survey of the construction companies was described.

The uncertainty in the study arose from the lack of similar past research in the construction industry such studies would indicate appropriate data collection and analysis techniques and what the response rates were likely to be. Despite all these limitations, the respondents were very helpful and supportive of the study. As a consequence, a substantial amount of data was received.

The thirty six percent (36.2%) usable survey response rate was considered high and representative enough to serve the purpose of this survey. The survey has been a success in yielding useful data and this success confirms the suitability of the data collection methodology used.

CHAPTER EIGHT: ANALYSIS OF THE DATA

8.1. INTRODUCTION

This chapter presents the results of the data analysis of the responses to the survey of contractors in the British construction industry. The analysis begins with interpretations of the respondents' profiles. The profile analysis describes the response rate, the sizes of the responding companies, the respondents' positions, and their experience in contractual decision making. Then analysis is divided into three sections that correspond to hypotheses H1, H2 and, H3 and H4 respectively.

8.2. BASIC BACKGROUND DATA ANALYSIS

Response Rate

Two hundred and ten (210) questionnaires were sent out. The responses to the survey is shown in Table 8.1. The typical response rate for a mail survey without follow-up is between 20 and 40 percent (Frankfort-Nachmias, 1992). The 48.1% response rate to the survey was better than expected. The nonresponse rate was more than fifty percent (51.9%) at the end of October 1993. It was possible that the response rate could have been improved by sending out reminder letters with follow-up copies of the questionnaire to those companies that had not replied. However, this was not done because the thirty six point two percent (36.2%) usable replies presented in Table 8.1. was high enough to satisfy the required response of at least twenty five percent (25%). Most of the non-usable replies were respondents that were not appropriate or who did not complete any large enough construction projects during 1991 - 1993.

Lansing and Morgan (1971) maintain that the simplest procedure to deal with non-response in analysis is to 'do nothing'. In effect, to do nothing amounts to assuming that the non-respondents are like the rest of the population. This assumption seems reasonable here. Because we found approximate similarity in general profile and many characteristics among those respondents and the non-respondents by using data available from the sampling frame. There were also the time and resource constraints that made follow-up techniques unappealing.

Table 8.1. The Survey Response Rate

	N	%
Mail out	210	100.0%
Non-responding	109	51.9%
Total Responding	101	48.1%
Non-usable Replies	25	11.9%
Usable Replies	76	36.2%

Sizes of the Responding Companies

The sizes of the companies that responded to the questionnaire are presented in Table 8.2. The classification was based on the annual turnover of the companies in 1991 and 1992. The information was provided by the *Key British Enterprises* (1993) and *Kompass* (1993/1994). The spread of the responding companies' turnovers from £3 million to £1,800 million was considered to have covered the full range of construction companies, except for those 'small' companies which were not included in the sample.

Table 8.2. Sizes of the Responding Companies

Annual Turnover (£m)	Size	N	%
3 - 11	Medium	9	12.0
11 - 50	Average	37	49.4
50 - 100	Large	13	17.3
100 - 1800	Very large	16	21.3
Total		75	100.0
Missing		1	

There are several criteria to measure the size of the organisation. Some of the criteria used include:

1) the number of employees
2) the assets of the organisation
3) the turnover of the organisation

There are several difficulties with these measures. The number of people employed may not accurately measure the size of the organisation in terms of its overall resources. Some organisations use higher levels of technology (such as automatic production) which reduce the number employed without necessarily reducing the overall resources of the organisation concerned. It may be argued that the use of such high technology in the construction industry is not yet a common feature. However, the dramatic improvements in construction methods, aided by prefabrication technology, suggest that companies can reduce the number of employees without reducing their sizes in terms of overall resources used.

The reference information on the sample companies showed that some had a small number of employees in spite of a relatively large turnover. Using the number of employees as the basis for classification would put such companies into incorrect categories.

Assets of the companies were not used as a basis for classification either. Accounting policies defining and ascertaining the values of assets varied between the construction companies. No consistent measures were then possible.

The annual turnover of the companies then appeared to be the most representative measure of the size of the companies. Another reason for choosing the turnover as a measuring criterion was that, apart from being an indication of their financial strengths, it was also suspected that the turnover of the companies may have some bearing on the companies' perception of risk. Turnover was chosen as the most appropriate measure of the size of the sample companies.

Values of the Projects (Contracts)

The values of the construction projects used by the responding companies are presented in Table 8.3. The questionnaire requested respondents to base their answers on projects of at least one million pounds. This limitation was due to circumstances which could be described as 'coincidental'. The concern of this study is the application of risk analysis techniques in the construction industry. It was felt that it was then more realistic to select larger projects undertaken by larger companies to provide most useful information.

These companies also have the technical capability that tends to focus on contracts of relatively high values. This tendency is also justified since spreading resources over a large number of small construction projects is less rewarding than concentrating on a limited number of relatively large projects of high values. It is left to be seen whether the project value has any relationship with perception of risk by the sample companies.

Table 8.3. Values of the Projects

Project Value (£m)	N	%
1 - 2	18	23.7
2 - 4	14	18.4
4 - 6	10	13.2
6 - 8	7	9.2
8 - 10	6	7.9
10 - 20	8	10.5
20 - 40	6	7.9
over 40	7	9.2
Total	76	100.0

<u>Types of Construction Projects</u>

The field of construction is as diversified as the uses and forms of the types of structures it produces. The difficulty of classifying companies on the basis of their different activities has already been described. In general, building construction which includes buildings in the commonly understood sense, other than housing, accounts for 35-40 percent of the annual total of new construction. Residential construction accounts for about 30-35 percent of new construction during a typical year. Engineering construction accounts for 20-25 percent. Industrial construction accounts for 5-10 percent (Clough, 1986). A more detailed workload is given in the *Housing and Construction Statistics* (DoE, 1994). In 1993, building construction which includes offices, commercial buildings, schools, hospitals, etc., other than housing, accounts for 38 percent of the annual total of new work. Housing accounts for 29 percent. Infrastructure which includes roads, bridges, sewers, etc., accounts for 23 percent. Industrial construction accounts for 10 percent.

The respondents chose the projects used for their answers. The projects in the surveys fall into the categories shown in Table 8.4., which would seem to provide a reasonable cross-section and be generally consistent with the general population.

Table 8.4. Types of Construction Projects

Project Types	N	%
Office and Commercial Building	25	33.8
*Houses	15	20.3
Factories	12	16.2
Roads and Bridges	17	23.0
Harbour and Offshore Works	3	4.0
Others	2	2.7
Total	74	100.0
Missing	2	

* Houses: including residential housing in public sector, university accommodations and hospitals.

Respondent's Managerial Positions

In spite of the fact that the 'contract decision making centre' would most probably be made up of a number of managers, only one questionnaire was mailed to each company. The questionnaire was addressed directly to the Managing Director of each of the sample companies with a request that he complete it or direct it to the 'appropriate project manager'. As it can be seen in Table 8.5., the people who responded to the questionnaire had a variety of managerial positions. Many of the companies had directed the questionnaires to the person who was considered most appropriate.

Table 8.6. summarises the experience of the respondents in decision making about contracts. Almost all respondents have been involved in contractual decision making for more than three years. The questionnaires were answered by those who had actually taken part in the decision making concerning the contract on which the answers were based.

Table 8.5. Respondent's Managerial Positions

Positions	N	%
Managing Director	37	49.3
Project/Contract Manager	10	13.3
Commercial/Sales Director	9	12.0
Chief Surveyor/Estimator	7	9.3
Construction/Building Manager	5	6.7
Risk Manager	2	2.7
Technical Director/Chief Engineer	2	2.7
Chairman	2	2.7
Quality and Safety Manager	1	1.3
Total	75	100.0
Missing	1	

Table 8.6. Respondents Decision Making Experience

Experience	N	%
Less than 3 years	2	2.6
3 - 5 years	6	7.9
More than 5 years	68	89.5
Total	76	100.0

8.3. PERCEPTION AND MANAGEMENT OF RISK BY CONSTRUCTION COMPANIES

Previous research on perceived risk has been concerned mainly with buyers as distinct from sellers. The survey examines how sellers in construction companies managed their perceived risks in their decision making about contract. This was analysed in hypothesis H1 as:

H1: Construction companies perceive risks in their contracting process, however the level of perceived risk is determined by situational factors.

The simple perception of risk by construction companies is illustrated in Table 8.7. The table is based on the answers given to a question which asked them if they perceived risks in their contract decision making process.

Table 8.7. Perception of Risk by Contractors

Perceived Risk	N	%
Yes	58	76.3
No	18	23.7
Total	76	100.0

Most constructon companies (76.3%) do perceive risk in their contracting process. However, the results also show that a large minority (23.7%) of the responding companies did not perceive risk in their contracting process. Previous studies indicate that perception of risk is a function of other factors (Sitkin and Pablo, 1992; Jackofsky et al, 1988; Douglas and Wildavsky, 1982; Binswanger, 1981; Crow, 1980; Newall, 1977). The question is no longer whether construction companies perceive risks but the factors which affect their perception of risk.

8.3.1. Factors Affecting Risk Perception

Some factors which previous research has found to influence the perception of risk included a variety of variables, such as:

* the amount of money involved
* the size of the organisation concerned
* the managerial position of the decision maker

These factors are likely to influence the perception of risk in construction companies. Other factors need to be considered too. These include:

* the type of construction project
* the type of contract
* the clauses included
* how knowledgeable the client is about his need

Therefore, we shall examine the possibile relationships between these variables and the perception of risk by construction companies.

Project Value

Based on literature review, we expected that the larger the project/contract value, the greater the number of contractors that perceive risk. This is formulated as hypothesis H1a. Table 8.8. shows average project values for companies which perceived risks and those that did not.

A clear distinction between the two groups emerges from an analysis of variance test. The mean level of project value was significantly higher in companies that perceived risk than those did not (0.01 level of significance). A chi-square test was conducted to determine if the differences were more than could be due to chance alone. The result of a chi-square test to determine the relationship between the risk perception and the project value is presented in Table 8.9. The calculated value of chi-square is 12.729, strong evidence that risk perception is related to the value of the project (0.01 level of significance).

Table 8.8. Mean Level of Project Value

Perceived Risk	N	Project Value (£m) Min	Max	Mean
Yes	58	1	50	13.97
No	18	1	14	3.58

F ratio=8.61 with D.F. Numerator=1 Denominator=74

To see how risk perception and project value are related, we can compare the Observed and Expected counts in Table 8.9. For project values from £1m to £4m, there are more companies not perceiving risks than expected and fewer companies perceiving risks than expected. For high value projects (above £10m), the reverse is true - there are fewer companies not perceiving risks than expected and more companies perceiving risks than expected.

Table 8.9.
Contingency Table for Risk Perception and Project Value

Perceived Risk		Project Value (£m) 1-4	4-10	Above 10	Total
No	O:	14	3	1	18
	E:	7.58	5.45	4.97	18.00
Yes	O:	18	20	20	58
	E:	24.42	17.55	16.03	58.00
Total	O:	32	23	21	76

O: Observed E: Expected
Chi-square=12.729 with D.F.=2

Construction project value had a considerable influence on the perception of risk. This relationship can be easily shown by Table 8.10. This table gives the percentage of subjects in each group of project values. Project values from £1m to £4m were perceived as risky by 56.25% construction companies, and 86.96% of projects valued from £4m to £10m were perceived as risky. For projects between £10m to £20m the percentage of risk perception incerased to 87.5%. For project values over £20m all companies perceived risk. We can then deduce that the relationship between risk and the value of project is positive as illustrated in Figure 8.1. Thus, the larger the project/contract value, the greater the number of contractors that perceive risk. So hypothesis H1a is supported.

Table 8.10.
Percentage Table for Risk Perception and Project Value

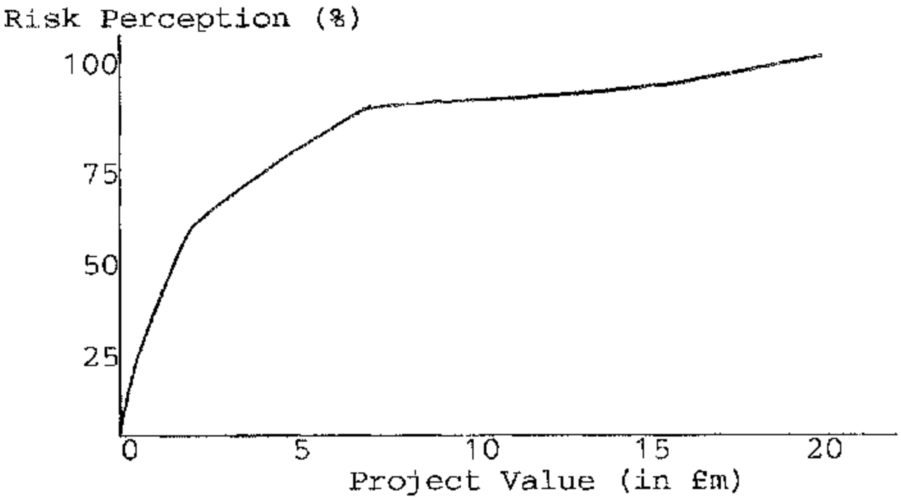
Perceived Risk		Project Value (£m) 1-4	4-10	10-20	Above 20
No	O:	14	3	1	0
	%:	43.75	13.04	12.5	0.00
Yes	O:	18	20	7	13
	%:	56.25	86.96	87.5	100.00
Total	O:	32	23	8	13

O: Observed %: Column percentage

Company Size

The possible association between the perceived risk of the contract making decision and the size of the company, measured by its annual turnover, was also investigated. It is hypothesised as hypothesis H1b that the larger the size of the contractor, the less likely it is to perceive risk.

Figure 8.1.
Risk Perception Curve in Respect of Project Value



Companies were assigned to one of the three categories depending on the annual turnover of the companies. Small companies were those with turnovers between £3m and £25m. Medium sized companies were those with turnovers from £25m to £60m. Those with turnovers above £60m were assigned to large companies.

A chi-square test measuring the effect of company size on risk perception is presented in Table 8.11. The calculated value of chi-square is 6.750, therefore the risk perception has shown significant association with company size (0.05 level of significance).

In Table 8.12., the survey showed that 60% of small companies perceived risk during their contract making decision, with this figure increasing to 76.92% in medium companies, and 91.67% in large companies.

Table 8.11.
Contingency Table for Risk Perception and Company Size

Perceived Risk		Company Size Small	Medium	Large	Total
No	O:	10	6	2	18
	E:	6.00	6.24	5.76	18.00
Yes	O:	15	20	22	57
	E:	19.00	19.76	18.24	57.00
Total	O:	25	26	24	*75

O: Observed E: Expected * One missing data
Chi-square=6.750 with D.F.=2

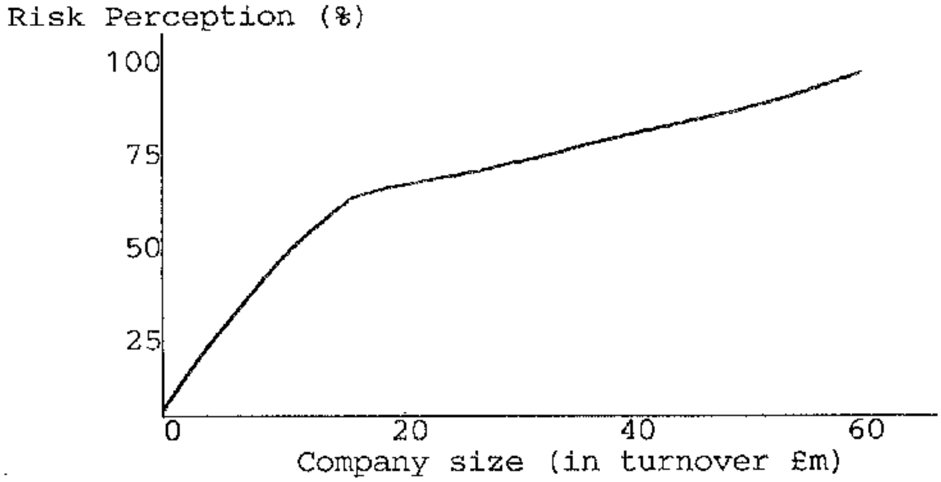
Table 8.12.
Percentage Table for Risk Perception and Company Size

Perceived Risk		Company Size Small	Medium	Large
No	O:	10	6	2
	%:	40	23.08	8.33
Yes	O:	15	20	22
	%:	60	76.92	91.67
Total	O:	25	26	24

O: Observed %: Column percentage

The relationship between risk perception and the company size is positive. It is different from what we expected an inverse relationship, thus not supporting hypothesis H1b. This is illustrated in Figure 8.2.

Figure 8.2.
Risk Perception Curve in Respect of Company Size



The positive relationship between risk perception and the sizes of the responding companies is not consistent with earlier research in Organisational Buying Behaviour discussed in Chapter One even though the present finding is concerned with the 'Selling Behaviour' of the construction companies. This finding raises questions about the assumed inverse relationship between risk perception and the size of organisation (Webster, 1969; Newall, 1977), which earlier research has accepted.

Table 8.13. shows that 72% of the small companies worked on projects valued from £1m to £4m, only 4% of them worked on projects valued above £10m (only one with a project value of £21m). On the other hand, 58.34% of the large companies worked on projects valued above £10m (mean project value = £36.71m), and only 8.33% of them worked on projects valued under £4m.

The simple positive relationship between the company size and the project value is strong (Pearson's r = 0.652). The scale and complexity of high value project also yield a simple positive relationship between risk and project size.

Table 8.13.
Percentage Table for Company Size and Project Value

Company Size (£m)	Project Value (£m) 1-4	4-10	Above 10
Small (3-25)	72%	24%	4%
Mean proj. value	2.14	5.75	21
Medium (25-60)	42.31%	34.62%	23.07%
Mean Proj. Value	2.50	7.56	17.67
Large (Above 60)	8.33%	33.33%	58.34%
Mean proj. value	3	7.25	36.71

%: Row Percentage

Havlena and DeSarbo (1991) maintained that price has the strongest effect on overall perceived risk. Newall (1977) concluded in his study that the primary risk determinants were the size of expenditure, the type of purchase, and the size of the decision group rather than the company size. Sitkin and Pablo (1992) maintained that the organisational control system was the primary risk determinant in an organisation.

The small numbers of respondents provide inadequate information to offer any further and meaningful explanation, the major conclusion relating to the company size and risk perception in contract decision making may now be drawn.

Although there is a high degree of association between the size of the construction company and risk perception, the size of the company does not appear to be a primary determinant and risk sensitive. Rather, it seems to be a situational or environmental phenomenon where the primary determinants are other characteristics of the company such as type of project, size of expenditure, decision making structure and financial standing.

Managerial Position

Earlier research found information search to be an active risk management strategy. A Managing Director as company head would always be supplied with greater information from different departments than individual department managers. More full and complete information may make Managing Directors less risk sensitive than other department managers with limited access to information. Therefore it is hypothesised as hypothesis H1c that contractors' decision makers in upper management will perceive risks to be lower than those in lower managerial positions.

Table 8.5. described the respondents' positions in their companies including nine different job titles. Because of the small number of observations within some positions a chi-square analysis would not be appropriate. Table 8.14. allows some deductions about the relationship the risk perceptions and managerial position.

The results in Table 8.14. show that 73% of the Managing Directors perceived risk in their contract decision process. This figure is smaller than that for Project/Contract Managers (100%), Commercial/Sales Directors (89%), Chief Surveyor/Estimator (86%), and Construction/Building Managers (80%), who are heads of different departments.

However, there was no meaningful relationship which could be attributed to managerial positions of the respondents and their perception of risk. A larger sample may have allowed such investigation. The result of a chi-square analysis for the first three job titles in Table 8.14. (Managing Director, Project/Contract Manager and Commercial/Sales Director) shows that managerial positions of the respondents in the construction companies do not seem to have any appreciable influence on the companies' perception of risk (chi-square = 4.138 < 0.90, with D.F.=2), thus not supporting hypothesis H1c. A chi-square analysis would not be appropriate if including other positions since the small number of observations.

Table 8.14.
Percentage Table for Risk Perception
and Managerial Position

Position	Perceived Risk Yes	No	N
Managing Director	*27(73%)	10(27%)	37
Project/Contract Manager	10(100%)	0(0%)	10
Commercial/Sales Director	8(89%)	1(11%)	9
Chief Surveyor/Estimator	6(86%)	1(14%)	7
Construction/Building Manager	4(80%)	1(20%)	5
Risk Manager	1(50%)	1(50%)	2
Chairman	1(50%)	1(50%)	2
Technical Director/Engineer	1(50%)	1(50%)	2
Quality and Safety Manager	0(0%)	1(100%)	1
Total	58	17	**75

* To be read: 27 out of 37 (73%) Managing Directors perceived risk
** One missing data

Types of Construction Projects

The construction projects in this study such as: houses, factories, commercial buildings, roads, bridges and offshore works, all fell into broad categories. All these different types of projects were amalgamated into two groups - building works and civil engineering works.

While no two construction projects can be identical it could, however, be maintained that in constructing buildings this uniqueness may be greatly reduced. Because of the relative complexity, uniqueness and size of the civil engineering works compared to that of building works, the civil engineering works will be perceived as involving higher risk than building works by construction companies. This is formulated as hypothesis H1e.

The results shown in Table 8.15. showed a clear distinction between the risks perceived in building works and those seen in civil engineering works. The 6.654 calculated value of chi-square suggested that civil engineering works had considerably greater perceived risks by construction companies. This relationship was found to be significant at the ninety nine percent (99%) confidence level (0.01 level of significance). Thus hypothesis H1e is supported.

Table 8.15.
Contingency Table for Risk Perception and Project Type

Perceived Risk		Project Type Building	Civil Eng.	Total
No	O:	17	1	18
	E:	12.65	5.35	18.00
Yes	O:	35	21	56
	E:	39.35	16.65	56.00
Total	O:	52	22	*74

O: Observed E: Expected * Two missing data
Chi-square=6.654 with D.F.=1

Standard/Non-standard Form

Construction contracts can be categorised as having standard or non-standard forms. Standard forms of contract have been thoroughly tested in practice and each party in the construction industry is familiar with their particular roles and responsibilities. Non-standard forms of contract are less familiar and need to be thoroughly checked to ensure that all the participants' interests are properly protected. Therefore we predicted in hypothesis H1f that using a non-standard contract will be perceived as involving higher risk than those with a standard contract.

Table 8.16. shows an analysis of the relationship between risk perception and contract form. The form of contract did not have any influence on the company's perception of risk (chi-square = 1.108 < 0.90). The risk perceived by a construction company using a standard form of contract was not significantly different from those using a non-standard form of contract. Thus hypothesis H1f is not supported.

Table 8.16.
Contingency Table for Risk Perception
and Contract Form

Perceived Risk		Contract Form Standard	Non-standard	Total
No	O: E:	16 14.45	2 3.55	18 18.00
Yes	O: E:	45 46.55	13 11.45	58 58.00
Total	O:	61	15	76

O: Observed E: Expected
Chi-square=1.108 with D.F.=1 Critical value (10%)=2.706

Types of Contract

When a client does his own building, he retains the authority over construction management and financial responsibility with its attendant risks. When a contractor is employed the client transfers to the contractor all or part of the authority for construction management and the financial responsibility. Risk perceptions of contractors are likely to be influenced by the types of contract. Therefore, we predicted in hypothesis H1g that using a price-based contract will be perceived as involving higher risk than those with a cost-based contract.

Tables 8.17. and 8.18. show the types of contract used by the respondents in this study and the relationship between the types of contract and risks perceived.

Table 8.17. Types of Contract

	N	%
Admeasurement	47	61.9
Lump sum	19	25.o
Management method	6	7.9
Cost-reimbursable	2	2.6
Target cost	2	2.6
Total	76	100.0

The results in Table 8.17. show that 86.9% of the contracts used by the construction companies in this study were the admeasurement contract and the lump sum contract. Both are price-based contracts. The results in Table 8.18. show that 83% of the contractors using admeasurement contracts and 74% of the contractors using lump sum contracts perceived risk. On the other hand, only 5.2% of the contracts used by the construction companies were cost-based contracts - cost-reimbursable and target cost, and only 25% (1 out of 4) of these contract users perceived risk. The small numbers of respondents provide inadequate information to offer further statistical analysis.

It is not surprising to find the result that only 5.2% of the contracts were cost-based contracts. Because, from the client's point of view, the ideal is a price-based contract. It establishes the amount of his commitment in advance, it provides the maximum incentive to the contractor to complete the work on time, and it reduces to a minimum the amount of administrative work involved after the contract has been let.

Table 8.18.
Percentage Table for Risk Perception and Contract Type

Contract Type	Perceived Risk Yes	Perceived Risk No	Total
Admeasurement	*39(83%)	8(17%)	47
Lump sum	14(74%)	5(26%)	19
Management method	4(67%)	2(33%)	6
Target cost	1(50%)	1(50%)	2
Cost-reimbursable	0(0%)	2(100%)	2
Total	58	18	76

* To be read: 39 out of 47 (83%) contractors using admeasurement contract perceived risk

For the contractor a price-based contract requires that he allows in his price for all risks imposed by the contract. His opportunity to maximise profit derives from his ability to reduce costs by planning the most efficient use of resources and exercising good control. Otherwise, anything wrong on the duration of the project, for example, unexpected ground conditions or inclement weather, will cause him a financial disaster.

The cost-based contract by definition does not guarantee a final cost. The client carries the whole of the financial risk while the contractor has the authority to manage the project risk. Indeed, the less efficient the contractor is, the greater the cost of the works and, possibly profit. This type of contract is naturally not popular with clients as the contractor has no financial incentive to efficiency.

Even though the contractors generally perceived less risk while using the cost-based contract others do not like it. In cost-based contracts the client will typically monitor work more closely.

As the industry has become more competitive and projects more complicated there have been moves to using management method (construction management and management contracting). This is a contractual arrangement that develops a team approach to building. The objective of this approach is to treat project planning, design, and construction as integrated tasks within a construction system. In the usual instance, the construction management contract is considered to be a professional services contract and is negotiated after extensive prequalification procedures. These contracts usually provide for fixed fee plus full reimbursement of field costs. Theoretically, contractors using these contracts perceive less risks. However, limited by the data received, it is difficult to determine the effectiveness of this approach in reducing overall risk to the contractor. More evidence is needed, but Hayes et al (1986) suggested that it reduced the risk of delay.

Despite the obvious lack of analytical rigour, the findings and discussions are sufficient to enable the following conclusion to be drawn. Price-based contracts, such as the lump sum and admeasurement, considerably increased the perception of risk for contractors, thus supporting hypothesis H1g.

Nevertheless, it should be noted that the greater the risk imposed on the contractor the greater the risk premiums added to the price to the client. In other words, the client has to trade off price and risk in their choice of contract.

While this study was being undertaken, the draft New Engineering Contract (NEC) model set of conditions of contract was issued by the Institution of Civil Engineers, initially for comment (ICE, 1991). This contract contains several advances on earlier models in relation to the analysis and allocation of risk. One of the aims of the NEC is to reduce the extent of disputes, on and off site, which arise from unclear or uncertain procedures in contracts (Barnes, 1991). By stating clearly the risks and the responsibilities for managing them it is intended that the overall management of risk will be seen to be much more the task of engineers and project managers and less that of lawyers and insurers.

Limited by the fact that none of the responding companies in this study adopting the NEC, it is impossible to make any comments on this approach. However, Thompson and Perry (1992) suggest that this contract has the following characteristics:

* It requires the user to choose his preferred contract strategy. This should achieve attention to the differences in the allocation of risk between various strategies.
* It contains a standard risk allocation between client and contractor and also permits a tailored allocation of special risks.
* It defines a single procedure for compensating the contractor when a risk occurs.
* It is designed to be simpler to read and understand than most other models.

Client's Knowledge of His Needs

The process of building is generally 'triggered' by the client recognising that he has a need. All the following stages, such as design and specification etc., stem from the client's needs. Client needs influence not only the nature of the product, but also affect the risks perceived by the construction company. Therefore, we hypothesised in hypothesis H1d that the risk perception by contractors is inversely related to the client's knowledge of his needs.

Table 8.19. shows the result of a chi-square test of the relationship between the risk perception of the construction company and the client's knowledge of his needs. The calculated value of chi-square is 3.004, implying that the client's knowledge of his needs has a significant association with the risk perceived by the construction company (0.1 level of significance). The client's knowledge of his needs is inversely related to the risks perceived by the construction company. Thus, hypothesis H1d is supported.

Table 8.19.
Contingency Table for Risk Perception and Client's Need

Perceived Risk		Client's Knowledge of Need: Knew generally	Knew exactly	Total
No	O:	7	11	18
	E:	10.18	7.82	18.00
Yes	O:	36	22	58
	E:	32.82	25.18	58.00
Total	O:	43	33	76

O: Observed E: Expected
Chi-square=3.004 with D.F.=1

8.3.2. Types of Risks Perceived

The question that provided the data in Table 8.7. was intended to focus on the first hypothesis. However, after establishing that companies did perceive risks it was then useful to identify the types of risks that the sample companies perceived. Since construction contracts tend to be unique the risks perceived in any particular contract will also vary according to the nature of the contract. Therefore, to find out what risks companies actually perceived, the respondents were asked to describe the types of risks they considered important.

Their answers were varied, from weather to ground conditions, from client's financial stability to labour problems, inflation and profit, etc. Table 8.20. illustrates the risks construction companies perceived. This table is based on the answers of the 58 responding companies which perceived risks in their contract decision making process. The percentage add up to more than 100% because some companies perceived more than one risk in their project.

In order to make the analysis more significant the responses have been classified into groups based on similar characteristics. As it can be seen in Table 8.20., the possibility of not being able to complete the construction project on time, the likelihood of not making any profit on the contract, and the possibility of not producing a satisfactory product, were perceived as risks by most of the responding companies (58.6%, 34.5% and 29.3% respectively). These are 'umbrella' risks that catch a wide variety of contributory problems. This is not surprising because, in practice, the three sources of risks are related. The relationship stems from the fact that failure on the part of the contractor to complete the project on time, or to produce satisfactorily may result in damages.

Table 8.20. Types of Risks Perceived (Total N=58)

Types of Risks	N	%
Completion date	*34	58.6
No profit	20	34.5
Performance of the product	17	29.3
Coordination between contractor and architect/engineer (not finding a good team)	17	29.3
Sub-contractor and supplier performance	16	27.6
Weather	14	24.1
On site operation	10	17.2
Labour relations	10	17.2
Client's financial instability	10	17.2
Material cost inflation	10	17.2
Ground condition	8	14.8
Contract condition	8	14.8
Fail to get tender	5	8.6

*To be read: 58.6% (34 out of 58) of the companies considered the possibility of not meeting the 'completion date' as one of the main risks they perceived.

Time, cost and quality are inextricably linked in any construction contract. Therefore, a delayed or defective product benefits neither the client nor the contractor. The risk implications of this relationship are increased by the fact that most construction contracts contain a retention clause and a liquidated damages clause as shown in Table 8.21. (Based on 76 responding companies).

Table 8.21.
Clauses Included in the Contracts (Total N=76)

Types of Clauses	N	%
Retention clause	*74	97.4
Liquidated damages clause	73	96.1
Provisions for variations	70	92.1
Determination clause	62	81.6
Performance bond	56	73.7
Conditions for price adjustment	32	42.1

* To be read: 97.4% (74 out of 76) of contracts on which responding companies based their answers contain a retention clause.

The principle behind the liquidated damages clause for delay is that it is assumed the client would suffer if completion is delayed. This is a transfer of non-completion risk from the client to the contractor. The amount of such loss, and implicit damages, may bear no relationship to the value of the contract. However, in commercial practice it is almost universal for such damages to be expressed as a percentage of the contract price. In fact, this must be so. No contractor can afford to be liable for a risk against which it is difficult to insure.

Although the total value of the liquidated damages is unlikely to be equal to the client's potential loss, the inclusion of the clause in a contract by the client, could, at best, serve as an intimidation of the contractor, and at worst, lead to unpleasant financial consequences for the contractor concerned. Obviously, this would reduce the contractor's profit on the contract. Hence, the relationship between the inclusion of a liquidated damages clause in a contract and the possibility of making no profit on the contract, due to failure to meet the completion date. It is also true that the relationship between the inclusion of a retention clause and the possibility of making no profit, due to failure to meet the product performance requirement.

Another important risk source is the possibility of not finding a 'good team' to work with, 29.3% of the responding companies perceived it as risk. The major participants in the construction process consist of the clients, their representatives such as the architect/engineer, and contractors. The complexity of most construction projects requires great coordination and team work. The project cannot succeed unless all parties cooperate and coordinate their activities successfully. Because the contractual relationship among the contractor, the client, and his representatives, is different from the relationship between the contractor and the subcontractor or supplier, this suggests that the contractor has no direct control over the client and his representatives. It is easy to say that there should be an appropriate balance of contribution from each party, mutual respect between them, and they should know of and support the objectives that it is to be achieved. However, in reality, there are 'good teams' and 'bad teams' in all businesses. The possibility of not finding a 'good team' is perceived as risk by contractor just as for all business.

Another important 'team work' related risk source concerns the performance of subcontractors and suppliers, 27.6% of the responding companies perceived this as a risk. Subcontractors and suppliers are vital components in the construction process. On an industrial building contract, the actual work to be carried out by the contractor's own labour may present only a third of the total effort (Marsh, 1981). Modern industrial activity is based on specialisation and the combining of specialist skills and construction materials to form an integrated whole. If the goods the supplier provides or the work the subcontractor carries out prove defective, the main contractor would normally be fully responsible for these defects caused by his subcontractors and suppliers. This explains why the performance of subcontractor and supplier was perceived as risk by contractor. Therefore, the relationship between the contractor and supplier/subcontractor becomes an important management issue. The idea of working closely with supplier/subcontractor appears as 'partnership sourcing', and has been discussed in Chapter Four.

Other risks listed in Table 8.20. have been described in previous chapters. Although the various risks have been identified generally the risks of any given project can only be identified correctly by considering its actual environment.

8.3.3. Methods Employed to Manage Risk

The perceived risks and their determinants by construction companies have been discussed in previous subsections, while this subsection is considered whether the companies manage the perceived risks. The questionnaire asked the respondent to identify the methods they use to manage the perceived risks. The answers were diverse. These have been classified into the groups shown in Table 8.22. based on the answers of the 58 companies which perceived risks.

Table 8.22. shows that 'careful planning' was used by most of the responding companies as a risk management method. The finding on 'careful planning' as a risk management method is significant since it confirms the views of Pilcher (1992), Argenti (1989), Colley et al (1977), and Hussey (1971), and also supports the views of Ashworth (1991), Hillebrandt and Cannon (1990), Stone (1988), and Adrian (1981) in Chapter Five and Chapter Six.

Table 8.22.
Risk Management Methods Applied by Contractors (Total N=58)

Risk Management Methods	N	%
Careful planning the project	*50	86.2
Careful monitoring the progress	49	84.5
Labour forces management	49	84.5
Sub-contractor and supplier selection	48	82.8
Keep close to the client and his adviser	47	81.0
Procuring sensitive materials early	44	75.9
Double checking key rates and preliminaries before submitting the bid	31	53.4
Renegotiate key points if the client makes changes	31	53.4
Well prepared before negotiation	25	43.1
Reasonable percentage of contingency fund	24	41.4
Proper provision for risk	23	39.7
Ready and willing to reschedule areas of work as problems arise	21	36.2
Careful drafting the contract	20	34.5
Improving the know-how	15	25.9

* To be read: 86.2% (50 out of 58) of the responding companies applied 'careful planning' to manage the risk.

The objective in construction work is usually that of completing a prescribed amount of work within a fixed duration and at the previously estimated cost. If contractors are to stay in business they must first obtain the work necessary to maintain near full utilisation. They must then carry out the work that he does obtain in such a way that he makes a profit. Since most work is given to contractors as a result of a competitive tendering procedure it is vital for contractors to plan their activities carefully before tendering for a contract. They must set down a realistic programme for carrying out the work while balancing the need for a competitive price with the estimated cost for carrying out the work. Pilcher (1992:233) stated that -

> "Planning, however, is the most important of the management processes and without it the proper and successful running of a company, a project, or a private life, must be very much a matter of chance."

The results also show that 84.5% of the companies managed the risk by 'careful monitoring the progress'. Monitoring project progress is a control issue. The objectives of planning process are to direct the work to proceed to meet all specifications within estimated costs. Control is the process of measuring the actual progress against these plans or standards and adjusting the use of resources to meet deviations from the original intentions. If plans and control are effective, successful construction can be achieved so that all parties profit. If these activities are done poorly problems will result in terms of the projects time, cost and quality.

Some responses not included in any of the groups in Table 8.22. are briefly described below. For example, the term 'careful planning' was used by most companies to manage 'bad weather conditions'. However, some companies stated that they managed the risk of bad weather by 'executing as much work in house as possible rather than on site'. One of the companies simply stated that 'prayer' was its risk management strategy.

The review in Chapter Three showed the relatively long time most construction projects take. This means that most construction contracts have a 'futuristic' factor that creates uncertainty and risk. For example, the needs of the client may change before the product is completed. This would cause considerable problems on the part of the construction company. To prevent this from happening, most construction products are legally sold before they are made. In other words, the futuristic factor makes it necessary to put in writing at the time of contracting, all the conditions which, not only establish binding obligations but also form the basis for the performance of the contract, and resolution of disputes which may arise between the parties involved in the contract. In this regard therefore, a well known and understood written contract and the wording of that contract, form part of the 'appropriate risk management methods' which construction companies employ to manage what they perceived as risks.

To test the validity of this conclusion, we asked the respondents to state whether their contracts were a standard form or a non-standard form. They were then requested to explain why they chose such a contract form. The responding companies' answers are presented in Table 8.23. and Table 8.24., which illustrate the form of contracts used and their reasons for preferring them.

Table 8.23. Form of Contract

Form of Contract	N	%
Standard form	61	80.3
Non-standard form	15	19.7
Total	76	100.0

Results from Table 8.24. show that most of the responding companies (62.3%) said they chose a standard form of contract because it was a well known, understood, and acceptable form successfully used in the past, and 49.2% of the responding companies said that it provided the best means of solving any conflict by established law case and precedent.

Table 8.24.
Reasons for Preferring Standard Form (Total N=61)

Reasons	N	%
Client's requirement	*42	68.9
Well known and understood	38	62.3
Good case law established	30	49.2
Fair risk share	24	39.3

* To be read: 68.9% (42 out of 61) of the responding companies expressed that it was the requirement of the client to use a standard form of contract.

Chapter One stressed 'buying from well tried or reputable sources' or 'brand loyalty' may be used to avoid or reduce decision risk. If a 'standard form', for example, JCT 80 or ICE conditions, is comparable to a reliable 'brand', then there is strong evidence to support the view that construction companies perceived it as a risk management method. However, most of the responding companies (68.9%) said they had no choice because the client dictated that it must be a standard form. This suggests that the client too, considered a reliable standard form of contract as a means of protecting himself against potential risks. This finding is consistent with the perceptions of consumer's buying behaviour.

Risks due to changes in the client's needs before the project is completed were analysed in Tables 8.25. and Table 8.26. The responding companies assessed whether there were changes in the design before the completion of the project and identified the source of the changes. The evidence provided shows that only 23.7%

of the projects were not changed or just changed a little. Some 76.3% of the designs were changed in one way or another before the projects were completed. Most changes were initiated by the clients. For example, results in Table 8.26. show that more than eighty percent (84.5%) of all the changes in the construction designs were initiated by the clients.

Table 8.25.
Design Changes and It's Source

Extent of Changes	Source None	Client	Contr	Both	Total
No changes	4	0	0	0	*4(5.3)
A few changes	**1	10	1	2	14(18.4)
Some changes	0	29	3	5	37(48.7)
Quite lot changes	0	10	0	0	10(13.2)
A great deal of changes	0	11	0	0	11(14.4)
Total	5	60	4	7	76(100%)

* To be read: 5.3% (4 out of 76) of the designs were not changed.
** One contractor didn't identify the source of design change.
Contr: Contractor

Table 8.26. Design Change Initiator

Initiators	N	%
The client	60	84.5
The contractor	4	5.6
Both	7	9.9
Total	71	100.0

Table 8.27., 8.28. and Table 8.29. present the reasons for the design variations, and their effects. The results in these tables show that 'changes in the needs of the client or the user' and 'faulty design or unclear early design' were responsible for more than forty percent (41.7%) and thirty percent (33.3%) respectively, of all the variations in the construction designs.

Table 8.27. Reasons for Changes in Design (Total N=72)

Reasons	N	%
Client's or user's needs changed	*30	41.7
Faulty design or unclear early design	24	33.3
To reduce production cost	16	22.2
To improve product performance	13	18.1
Unforeseen underground condition	10	13.9
To make project more viable	8	11.1

* To be read: 41.7% (30 out of 72) of the responding companies cited changes in the needs of the clients or users as a factor causing variations in the design.

The evidence provided shows that 53.3% (32 out of 60) of the design changes initiated by the clients caused considerable effects on contractors' performance. The results also indicate that 32% (23 out of 72) of the contractors stated, at least in their eyes, that design changes caused their project delay in delivery. Of course, this is not to suggest that contractors themselves are not also responsible for similar failures.

Table 8.28.
Effect of Design Changes on Performance and It's Source

Level of Effect	Source Client	Contr	Both	Total
Not at all	15(25.0)	3	3	21(29.6)
A little	13(21.7)	0	2	15(21.1)
Some	*14(23.3)	1	1	16(22.5)
Quite a bit	*13(21.7)	0	1	14(19.7)
A great deal	* 5(8.3)	0	0	5 (7.1)
Total	60(100%)	4	7	71(100%)

* To be read: 53.3% (32 out of 60) of the design changes initiated by the clients caused considerable effect on contractors' performance.
Contr: Contractor

Table 8.29.
Effects of Design Changes on Performance (Total N=72)

Effects	N	%
Delay in completion date	*23	32.0
Disruption of planned progress	20	27.8
Delay in material procurement	13	18.1
Production cost increases	10	13.9
Difficulty in allocating resources	9	12.5
Reduce material cost and save construction time	6	8.3

* To be read: 32% (23 out of 72) of the projects were not completed on time as a result of changes in design.

NEDO (1970) found similar results, contractors in the industry saw late design changes as the major cause of delay. In fact twenty seven percent (27%) of the total contractors ranked late design changes first as a cause of delay. Changes in the client's needs their inevitable effect on design can be a serious impediment to the timely completion of work, and can be expensive.

The overall evidence from Tables 8.25., 8.26., 8.27., 8.28. and 8.29. justifies construction companies' use of legally binding contracts as a risk management method. However, the extent to which a contract can help manage risk for a contractor may depend on the wording of the contract, especially in the specific clauses used.

Table 8.21. illustrated the types of clauses which were commonly included in the contracts. The results show that most of the contracts (92.1%) identified conditions in which there could be alterations in the project design. These provisions for variations were intended to protect the construction company against risks arising from changes in the needs of the client.

The inclusion of liquidated damages clauses and retention clauses introduces a risk factor for the construction company. These provisions that allow variations in the original design can become both a risk factor, and a risk management method.

Most of the project designs (76.3%, see Table 8.25.) change in one way or another. These changes or variations could cause changes in production schedules, materials procurement, and other problems. At worst, they could make the project under the 'new' requirements, though this is not common. It is in this sense that construction companies see the possibility of variations in a design as a source of risk. On the other hand, the fact that a contract allows consideration of design variations also protects the construction company against changes that might increase its cost without requiring corresponding financial compensation from the client. For example, the contract may place the construction company in a favourable negotiating position when it comes to settling a price for the variation. The cumulative effect of a number of variations on the design can be extremely serious and result in disproportionate disruptions of work, loss productivity and so on. Construction companies can actively manage risk by including in the contract the specific conditions under which design variations will be considered, and the handling of costs and delays that result.

Construction companies may also consider price adjustment clauses to protect the company against risks arising from price changes after the contract has been signed. Table 8.30. shows that even with lump sum contracts more than thirty percent (31.6%) included conditions for price adjustment, and 40.4% of the admeasurement contracts included such price fluctuation clauses.

Table 8.30.
Price Adjustment Clause Used in the Price-based Contract

	Price Adjustment Clause Used		
Contract Type	Yes	No	Total
Lump sum	*6 (31.6%)	13 (68.4%)	19
Admeasurement	19 (40.4%)	28 (59.6%)	47

* To be read: 31.6% (6 out of 19) of the lump sum contracts included conditions for price adjustment.

If the risk element in quoting a fixed price can be well defined and possible price increases are relatively small under competitive conditions then both the client and contractor would be likely to prefer a fixed price. However, if any of these assumptions are not correct then, the balance of advantage for both sides would seem to lie in favour of at least limited price adjustment.

Price-based contracts, such as lump sum and admeasurement have considerable influence on the perception of risk by contractors. It may be very difficult to estimate the amount of the 'cover' required so contractors may be exposed to serious loss if he under-estimates. The intensity of the competition may prevent the contractor from including an adequate element of cover if he wishes his bid to have a high probability of acceptance. The significance of the 'cover' in relation to the contract price, will be largely a function of the duration of the contract or project. This is especially true in an era of rising prices and wage-rates. Many construction companies regard price adjustments in contracts as a risk management method, whereby they are entitled to claim for increased prices and wages.

The analyses of the survey has shown that construction companies used various methods to manage perceived risks in price changes and design changes.

8.3.4. Section Conclusion

The analyses of the results show that the responding companies perceived risk in their contract decision making process. Risk perception was found to be associated with a number of factors such as:

* the value of the contract
* the size of the company, measured by annual sales turnover
* the types of the construction project
* the types and the wording of the contract
* the client's knowledge of his need

The nature and types of the risks contractors perceived varied widely. The methods which they adopted to manage these perceived risks also varied. These findings have supported the hypothesis H1 that construction companies perceive risks in their contract decision making process, and some situational factors affect the risk perception.

8.4. THE APPLICATION OF RISK ANALYSIS

Risk is inherent in all construction work. Size can be one of the major influence on risk perception and other factors that affect risk include the complexity of the project, its location, the speed of construction and the contractor's familiarity with the type of work involved.

Past evidence revealed that these risks were not adequately dealt with. A report (NEDO, 1975) on the performance of public sector construction projects found that one in six contracts were delayed by more than 40% of the original contract period, and a significant number by more than 80%. Another study on the speed of industrial building in the UK (NEDO, 1983) confirmed that too many projects had overrun both cost and time targets. However, ten years have passed since the 1983 report and programmes are now available to carry out risk analyses and many can be adapted to the needs of individual organisations. Thompson and Perry (1992) indicated that a large number of detailed and sophisticated methods are available for risk analysis. These methods have been claimed to be useful by their developers but it seems that the application of these sophisticated techniques in construction industry was restricted. This section will examine how effective or successful these risk analysis techniques were in meeting the objectives of the construction companies. This was stated as a hypothesis:

H2: Rigorous risk analysis techniques are not widely applied in the contracting process of the construction industry, instead the more traditional techniques are still favoured for risk analysis.

Hypothesis H2 will be examined by analysing the relevant responses from the survey and the interviews.

8.4.1. The Use of Risk Analysis Techniques

Hypothesis H2 is restated as hypothesis H2a that construction contractors prefer traditional qualitative risk analysis techniques, such as checklists, brainstorming and expert interviews, to quantitative analysis techniques in performing risk analysis. Tables 8.31. and 8.32. illustrate the use of the risk analysis techniques by responding companies in their precontract procedures. The data of these tables are based on the responding companies' answers to the following questions.

Q15(a). Did your company use risk analysis techniques such as SENSITIVITY ANALYSIS, PROBABILITY ANALYSIS, DECISION TREE ANALYSIS, etc. in its decision making process about the preparation and the submission of the bid? These answers are summarised in Table 8.31.

Q15(b). If 'Yes', what were these risk analysis techniques used and used for? These answers are summarised in Table 8.32.

The use of rigorous risk analysis techniques by construction companies is obviously not encouraging. Only four (4) of the seventy-six (76) responding companies replied that they have applied sensitivity analysis, and two (2) companies have applied probability analysis in their precontract investigation. Some respondents (5) even indicated that they do not know what these methods were. The respondents identified some other techniques that are used. These were checklists (33), brainstorming (28), expert interviews (24) and common sense (12).

Rigorous risk analysis techniques provide new and much more formal and comprehensive ways to evaluate and compare the degree of risk and uncertainty associated with decisions (Newendorp, 1975). In view of the low level of usage of these methods further investigation was needed. The results allow an interpretation that construction companies do not use formal or rigorous quantitative methods of any sort in evaluating or managing risks.

Table 8.31.
Contractors Using Risk Analysis Techniques

Quantitative Techniques Used	N	%
Yes	6	7.9
No	70	92.1
Total	76	100.0

Table 8.32. Types of Risk Analysis Techniques Used

Types	N
Sensitivity Analysis	4
Probability Analysis	2
Checklists	33
Brainstorming	28
Expert interviews	24
Common sense	12

8.4.2. Present Risk Analysis Approaches Applied

The author visited eight (8) contractors and discussed their failure to use quantitative methods with them. From the discussion, failure to use risk analysis, in general, can be attributed to the following arguments:

* Lack of awareness: The contractor is unfamiliar with risk analysis and unaware of its potential contribution.

* Lack of expertise: The contractor lacks the resources to carry out risk analysis.
* It is unnecessary: The contractor considers that a formal detailed, quantitative analysis is not needed.
* Lack of time: The contractor takes the view that there is not enough time to carry out risk analysis within the specified project deadlines.
* Difficult-to-quantify risks: The contractor perceives that risks are too difficult to quantify.

In the author's view, virtually all of these arguments indicate a lack of understanding of the potential contribution of risk analysis to construction project. However, these contractors emphasised that although they did not use 'quantitative risk analysis techniques' to assess or manage project risks, they did use 'qualitative risk analysis' in their decisions to tender for a contract. The discussions also showed that the more traditional techniques are still favoured by contractors for carrying out project risk analysis and management. The results of interviews were consistent with the results shown in Table 8.32. Three commonly used techniques are listed below -

* check lists of risks compiled from previous experience
* interviews with key project participants
* brain-storming with the project team

The objective was to compile a list of the main risk sources and a description of their likely consequences, usually including an approximation of their potential effect on cost and time. Respondents believed that the benefits of risk management come from the identification rather than analysis stage. Respondents also believed that this qualitative analysis was essential and brought considerable benefit in understanding the project and its potential problems. These also provoked thought about management responses to the risks. For them, great benefit comes from the discipline of thinking through the project, understanding the potential risks, and considering possible responses. Thus, both the results shown in Table 8.31 and 8.32 and the discussions with contractors supported hypothesis H2a.

They also indicated that most contractors have a department responsible for estimating the work described in the contract documents, and performing any risk analysis. Their views are consistent with the results shown in Table 8.33.

Table 8.33. is based on the 44 responding companies that answered the question about the department responsible for risk analysis. However, it is surprising to find that only two companies have Risk Department to administer the risk analysis, thus supporting hypothesis H2b that the construction companies do not use risk departments.

They also described the functions of the estimating department. Usually the estimating department is the first department to have any contact with a prospective contract and is required to deal with documents prepared by the client or his representatives. The estimators in the course of preparing an estimate and tender liaise with the client and internally with planning staff, buying staff, plant managers, site management staff and senior management. Thus the estimator's tasks are not simply ones of calculation but of collecting the relevant data, identifying and assessing risks involved, and explaining them to senior management. Thus both the results shown in Table 8.33. and the discussions with contractors supported hypothesis H2c that the estimating department carries out risk analysis in a traditional way.

Table 8.33. Department Reponsible for Risk Analysis

Department	N	%
Estimating	17	38.6
Production/Engineering	9	20.5
Finance	5	11.4
Planning	4	9.1
Procurement	4	9.1
Risk	2	4.5
Quantity Surveying	2	4.5
Marketing	1	2.3
Total	*44	100.0

* Only 44 companies answered the question

The estimated cost to a contractor of carrying out the work is known as the construction cost and is composed of the direct cost of carrying out the work to which are added the site overheads and company overheads. A direct cost consists of the cost of the resources - materials, labour, equipment, and subcontractors needed to carry out a specific, well-defined item of work. The construction cost then forms the basis for determining the net cost for a contract.

However, these respondents also admitted shortcomings in their present systems. The estimator too often considers the potential risks of cost inflation for labour, plant, material and subcontractors, and neglects other possible risks. Bearing these risk factors in mind and lacking quantitative risk analysis the estimator almost always identifies a higher cost estimate, thus supporting hypothesis H2d that estimators tend to over-compensate their cost estimates in determining the bid. This decreases the bid's probability of being accepted.

After the submitting of the estimate, next important decision to be made is to decide the tender price. Tendering is the process whereby a contractor, given the estimate, converts this to the sum what will actually be submitted to the client. At this stage the principal discussions are concerned with the profit and the risk, together known as the margin or the mark-up. In order to determine the mark-up, an assessment of the possibilities of over or underestimation of the costs is made. Where, for example, a tunnel is to be driven through waterlogged ground containing boulders, a relatively high allowance for risk will be required because of the possibility of disruptions and delays to the work. For building a standard, two-storey, detached house, on the other hand, the risk of experiencing construction difficulties is very low. It is at the tendering stage that judgements of this kind need to be made.

The decision to bid is mainly the responsibility of senior management. This is done after studying the reports prepared by the estimator and investigating their assumptions and decisions, and considering other factors such as market situation and the state of competition.

The pricing decision is so important that previous researchers (Harris and McCaffer, 1989) have suggested it should be decided by a senior management panel. This would consist of the managers of the risk analysis and estimating departments as well as the managing director himself. Their views would be broader than those of an individual. However, the survey results shown in Table 8.34. reveal that 64.2% (43 out of 67) of the responding companies have tender prices decided by their managing directors, especially in those small (72.7%) and medium (82.6%) companies. The survey also shows that 63.6% (14 out of 22) of the large contractors have tender prices decided by senior management committee. The results show that most companies have the tender decisions decided by managing directors' individual judgement rather than the group decision. The management committee is established to decide the price in most large companies.

Table 8.34. Who Decides the Tender Price

Bid Decider		Company Size Small	Medium	Large	Total
Managing Director	O:	16	19	8	43
	%:	72.7	82.6	36.4	64.2
Management Committee	O:	6	4	14	24
	%	27.3	17.4	63.6	35.8
Total	O:	22	23	22	*67

O: Observed %: Column Percentage
* 67 Companies answered the question

No matter who determined the final tender price, the survey found that the estimator played a very important role in preparing the estimate and in determining the tender price. Table 8.35. illustrates the influence of different people on the tender price. The data is based on the respondents rating, in terms of importance, the people who helped determine the bid price.

The results show that 44.7% of the contractors indicated that the estimator was the most important in the tender decision making process and another 42.1% indicated that the estimator was the second ranking in importance. Using estimators to produce suitable information is a risk management method for senior management. However, this heavy dependence upon the estimator is a risk too. Because of the estimator's generally conservative perspective they usually suggest a higher bid price to allow for risk and profit. The result of this behaviour too often is that the company fails to win the contract.

Table 8.35.
The Importance of the People in Determining the Bid

	Least	<-----	Importance	----->	Most	
Position	1	2	3	4	5	N
Estimator	1	1	8	32	*34	76
	1.3	1.3	10.6	42.1	44.7	%
Executive director	2	1	6	10	49	68
	2.9	1.5	8.8	14.7	72.1	%
General manager	6	3	9	20	15	53
	11.3	5.7	17.0	37.7	28.3	%
Engineer/Architect	13	6	15	16	8	58
	22.4	10.3	25.9	27.6	13.8	%
Production manager	6	6	18	17	6	53
	11.3	11.3	34.0	32.1	11.3	%
Accountant	32	12	7	3	1	55
	58.2	21.8	12.7	5.5	1.8	%
Financial adviser	24	9	8	7	3	51
	47.1	17.6	15.7	13.7	5.9	%

* To be read: 34 out of 76 (44.7%) contractors indicated that the estimator was most important in helping to decide the bid

The number of responses to the question varied widely from 76 to 51 in Table 8.35. A possible explanation of the variation is that it reflects how responding companies perceived the relevance and the importance of the various positions in terms of the companies' tender decision making process. This seems to suggest that some of the positions included in the question were either irrelevant to the companies' situations, or were not important in the companies' tender decision making.

Discussions with contractors also revealed that on many occasions the estimate is adjusted in the form of a lump sum addition. The additions are frequently referred to as the 'mark-up' and are allowances for risk, overheads and profits. However, because of a lack of quantitative risk analysis techniques, they admitted that all too often risk is dealt with in an arbitrary way - simply adding a certain amount of 'contingency', say 10%, decided by senior management intuitive judgement, onto the estimated cost of a project. Therefore, in general, most construction companies did not apply rigorous risk analysis techniques in their decision making process about the preparation and the submission of the bid.

8.4.3 Section Conclusion

The analysis of the results has shown that the simplest of all the techniques (checklists) is the most favoured and is in heavy use. However, even where some form of risk management was undertaken the full range of systematic risk analysis and risk management techniques were not applied by most construction companies. These findings have supported hypothesis H2 that rigorous risk analysis techniques are not widely applied in the contracting process of the construction industry, instead the more traditional techniques are still favoured for risk analysis. From these discussions several weaknesses were identified in presently used methods of risk analysis.

First, there is a tendency to double-count risks because some estimators include contingencies even in their 'best' estimates.

Second, the percentage figure generally used to cover risks is arbitrarily arrived at and not tailored for any specific contract and its unique risks.

Third, because the percentage used allows for all risk in terms of their potential cost it does not encourage creativity in estimating, allowing it to become routine and mundane. This also directs attention away from time, performance and quality risks.

Risk analysis is concerned with uncertainty and its consequences. Risk analysis techniques consider probabilities and probability distributions, in order to assess the combined impact of risks on the project. Since few construction companies use risk analysis techniques they should start slowly, perhaps by establishing a risk management team first, rather than a risk management department. Then, analysis should be carried out by those trained to do so jointly with cost estimators and project planners, until confidence is gained. Analysis can then be extended to judging the probability of occurrence of each risk and its possible consequences, rather than the traditional single figure values.

The results of risk analysis can be useful indicators of trends and problems but they should not be used as the sole guide in decisions. On the other hand, the need for judgement should not excuse a failure to consider project risk.

8.5. RISK MANAGEMENT IN CRITICAL STAGES OF A CONSTRUCTION CONTRACT

The review in Chapter Four demonstrated that the process which eventually leads to the winning of a contract is primarily a selling/buying process. As such, most construction contracts evolve through stages and some may be defined as 'focal points' or 'critical stages'. Chapter Five considered the tendering stage and Chapter Six focussed on the commitment stage. Both were defined as critical stages in the process. Effective risk management must deal with risks in these critical stages. Consequently, the following hypotheses have also been formulated:

H3: The tendering stage is the most important phase for applying risk management primarily through an effective bidding/negotiating approach.

H4: The successful execution of the construction work largely depends on the contractor's resources and management ability. Hence 'Management Risk' is the main risk in the contract commitment stage.

The objective of this section is to analyse survey responses to draw valid conclusions on these hypotheses.

8.5.1. The Tendering Stage

Most writers (Skitmore, 1989; Warby, 1984; Ramsey, 1980; McCaffer, 1976) on competitive bidding see the tendering stage primarily in terms of profit or loss, whereas a more useful approach perceives the profit or loss in terms of effectiveness of the risk management methods which the company may apply.

The analysis of responses relating to this hypothesis will establish the importance of the tendering stage. This is to be indicated by the number of contracts obtained through competitive bidding, and from the methods employed to manage risks. Table 8.36. illustrates how contracts were obtained by construction companies surveyed.

Table 8.36. The Methods Contracts Were Obtained

Methods	N	%
Selective competitive tender	23	30.3
Selective competitive tender and negotiation	21	27.6
Open competitive tender	18	23.7
Open competitive tender and negotiation	5	6.6
Negotiation only	9	11.8
Total	76	100.0

The results show that 30.3% (23 out of 76) of all the contracts were obtained through selective competitive bidding , and 23.7% (18 out of 76) were obtained through open competitive tender. Over 50% of all contracts awarded were based purely on competitive approaches. This also shows the dominant role which selective competitive bidding has assumed in the competitive sector of the construction industry since it was strongly recommended in 1983 (ICE, 1983). The results also show that 34.2% (26 out of 76) of the contract were obtained through both competitive bidding and negotiation (two-stage tendering). These findings have supported hypothesis H3a that the preferred mechanism for letting contracts is the traditional competitive tendering, especially the two-stage tendering.

The importance of the tendering stage is also demonstrated by Table 8.37. which identifies the stage in the contract decision process at which they and their companies became involved. The results show that 49.3% (37 out of 75) of the respondents themselves, and 54.1% (40 out of 74) of the responding companies, became officially involved in the contracts only when tenders were invited. The table shows the critical position of the tendering stage.

In competitive tendering the contractor's chances of winning any contract depends on the effort spent in this stage. In this regard, the following analysis will be concerned with the strategies which construction companies applied to secure the contracts.

The review in Chapter One identified information search and utilisation as an effective strategy for managing perceived risk. Tables 8.38., 8.39. and 8.40. illustrate the information search made by construction companies. The tables are based on the answers given to questions about investigations made of contracts before submitting their bids, what they hoped to find out, and what they did with the resulting information after the investigation respectively.

Table 8.37. The Stage when Contractors Involved

	Respondent		* Company	
Stages	N	%	N	%
Conceptual stage	9	12.0	15	20.3
During design	11	14.7	14	18.9
After design	8	10.7	5	6.7
Tenders invited	37	49.3	40	54.1
Bid submitted	10	13.3	0	0.0
Total	75	100.0	74	100.0

* Company: Other staffs of the company than the respondent himself

The results show that most construction companies searched for and utilised information as a risk management strategy. Table 8.38. shows that 81.6% of the responding companies undertook their own investigations of the contracts for which they intended to offer bids.

Table 8.39. shows that 83.9% of the responding companies undertook their own investigation to determine whether the conditions of contract imposed any special risks in the nature of the work to be carried out, and to identify whether contract confirmed with the company's contracting policy.

Table 8.38. Information Search by Contractors

Undertaking Investigation	N	%
Yes	*62	81.6
No	14	18.4
Total	76	100.0

* To be read: 81.6% (62 out of 76) of the responding companies undertook their own investigation.

Table 8.39.
Information Seeking from Investigation (Total N=62)

	N	%
Potential risks of contract conditions	52	83.9
More information to improve bid success	47	75.8
Verification of supplied information	39	62.9
Investigation of design alternatives	31	50.0
Client's actual need	*25	40.3
Specific local advice on site	24	38.7

* To be read: 40.3% (25 out of 62) of the responding companies undertook their own investigation on the contracts to find out whether the available information on the contract was accurate to enable the company satisfy the needs of the client.

This finding is consistent with the findings of Section 8.3. that the tender documents and drawings contain details on the financial risk element in the contract. The inclusion of appropriate wording in contracts becomes a risk management strategy for a construction company. This explains why most of the responding companies searched for more information about contract conditions.

Table 8.39. also shows that 75.8% of responding companies sought more information about site conditions, neighbours, adjacent structures, competitors, bill of quantities etc., in order to improve the probability of bidding successfully.

Table 8.40. shows that most of the responding companies (86.8%) based their bids on both the tender documents supplied by the client, and the results of the companies' own investigations. This suggests that most construction companies did not just use available information to prepare and submit their tenders, but that they took steps to ensure that they were not misled by the information supplied when drafting their tenders.

Although 53.9% of the bids were based primarily on tender documents, we still could conclude that information search plays an important role in bid preparation at this stage.

Table 8.40.
Information that Bids Were Based on

	N	%
Primarily on own investigation	1	1.3
Own investigation and tender documents	24	31.6
Primarily on tender documents	41	53.9
Tender documents only	*10	13.2
Total	76	100.0

* To be read: 13.2% (10 out of 76) of the bids submitted were based on tender documents only.

To discern whether there was any relationship between companies' perception of risk and the undertaking of information searches, a cross-tabulation procedure was used. In other words, risk perception was cross-tabulated by companies' investigations. Statistics chi-square and Kendall's tau-b were selected. The choice of statistics was justified on the ground that it would enable a more clear picture to emerge about the relationship between risk perception and information searching.

In Table 8.41., the results of a chi-square test and the value of the Kendall's tau coefficient are presented. The 3.490 calculated value of chi-square suggests that the companies' undertaking of investigation has shown significant association with their risk perception (0.1 level of significance). In view of this evidence, it is reasonable to conclude that there is a positive relationship between the perception of risk and their search for information to manage perceived risks. Thus these findings shown in Table 8.38., 8.39., 8.40., and 8.41. have supported hypothesis H3b that active information seeking is used by contractors in preparing their bids as a risk management method. There is a positive relationship between the perception of risk and the search for information.

Table 8.41.
Contingency Table for Risk Perception and Investigation

Perceived Risk		Investigation No	Yes	Total
No	O:	6	12	18
	E:	3.32	14.68	18.00
Yes	O:	8	50	58
	E:	10.68	47.32	58.00
Total	O:	14	62	76

O: Observed E: Expected
Chi-square = 3.490 with D.F.= 1
Kendall's tau-b = 0.214

The value of Kendall's tau-b 0.214 indicates a correlation between risk and information search. A perfect positive correlation gives a correlation coefficient of +1, while a perfect negative correlation yields a correlation coefficient of -1. The correlation coefficient of 0.214 is low and seems to indicate that, although the relationship between perception of risk and the information search is significant, the correlation between the two variables is not as strong as the level of significance of the chi-square would suggest.

Lee (1993), Cohen and Holliday (1982) offer a descriptive interpretation as a rough and ready guide to the meaning of r and believe that values of less than 0.39 designate a low correlation, and the value of 0.21 is just above the 'very' low category.

Prus (1989), Parkinson and Baker (1986), Young and Mondy (1978) have suggested that a knowledge of the buyer allows the seller to act in ways that the buyer will find acceptable. Therefore, determining who is involved in or influences the buying decision for the purchasing organisation may be essential to enable a successful or effective sales approach.

In investigating this viewpoint the construction companies were asked whether they identified who was likely to assess their bids in the client's organisation; and, if so, whether the assessors characteristics were taken into account in preparing the tender. Tables 8.42. and 8.43. illustrate the responses.

Table 8.42. Identification of Bid Assessors

Assessors Identification	N	%
Yes	60	78.9
No	16	21.1
Total	76	100.0

Table 8.43.
Levels of Background Identification

Levels	N	%
Not at all	8	13.0
A little	6	10.0
Some	19	32.0
Quite a bit	17	28.0
A great deal	10	17.0
Total	60	100.0

The results show that 78.9% (60 out of 76) of responding companies identified the assessors of their bids before they were submitted. Among them, only 23% (14 out of 60) did not take much account of assessor's background when they were preparing bids for the contracts. Others (77%) believed that they had considered assessor's background when preparing bids, since it might improve their bid's success.

In Chapter Five, the considerable emphasis on the bid price was noted. It was suggested that a contractor's profit on a contract depend not only on the bid price but also on winning the contract. Table 8.44. illustrates the various methods used to determine bid prices. This table is based on seventy (70) responses that described the approaches used to arrive at their bid prices. The answers were diverse but they have been classified into the three groups shown in the table.

The table shows that 55.7% (39 out of 70) of the responding companies based their bid prices on a small margin of profit compared to the profit received a couple of years ago. Some companies indicated that competition left little room to maneuver for large profits in recent years. The survey also shows that 30% of companies based their prices on the level of competition. A number of companies indicated that they lowered prices in order to win bids because of the need to obtain work.

Table 8.44. Basis for Determining Bid Price

Factors	N	%
Cost plus small margin of profit	39	55.7
Cost adjusted by anticipated competition	21	30.0
Cost plus profit and contingency for risks	10	14.3
Total	70	100.0

In the present economic conditions a majority of the construction companies are suffering hard times. However, the 'winning and losing' syndrome is not seen. Construction companies do not abandon the profit objective, although their primary objective of submitting bids is to win contracts.

Only 14.3% (10 out of 70) of the responding companies indicated that they based bid prices on a consideration of covering potential risks. However, it seems unlikely that contractors would consider a bid price to including a small profit if it did not also consider the potential risks that could erode any profit on the project. It would then seem that a price that provides a small profit, and one that covers risks, may basically be the same. In general, the responses in Table 8.44. support the perspective that in most cases price is the determining factor in winning contracts.

Table 8.45. ranks the factors thought to determine the winning of contracts. The data is based on the respondents' rating (on a scale of one to five) of factors that influenced the winning of contracts. However, this is only the contractor's beliefs rather than the client's perspective.

Although clients are becoming less price sensitive (Fellows and Langford, 1993), the data show that 56.7% of the responding companies still considered Low Price as the most important factor in their winning of contracts, thus supporting hypothesis H3c that price is the most important factor in winning contracts. Other factors such as: company's reputation, company's good financial standing, early completion date, prior business relationship with the client, the skill of the negotiation team, and good industrial relations of the company were also considered very important by construction companies. Some companies indicated (not shown in the table) that prior experience, awareness of client's key needs, and awareness of competitor's strategy were also considered as very important.

Table 8.45.
Factors which Influenced the Winning of Contracts

	Importance Least <-----------> Most					
Factor	1	2	3	4	5	N
Low price	1 1.4	1 1.4	12 16.2	18 24.3	42 56.7	74 %
Reputation	3 4.1	0 0	12 16.2	33 44.6	26 35.1	74 %
Financial standing	3 4.1	2 2.7	18 24.3	27 36.5	24 32.4	74 %
Early completion	6 8.8	6 8.8	17 25	22 32.4	17 25	68 %
Prior relationships	15 21.8	7 10.1	11 15.9	21 30.4	15 21.8	69 %
Negotiation skill	7 11.3	10 16.1	24 38.7	17 27.4	4 6.5	62 %
Industrial relations	21 32.8	13 20.3	14 21.9	12 18.8	4 6.2	64 %
Company's proximity	23 35.4	15 23.1	16 24.6	9 13.8	2 3.1	65 %
Selling tactics	22 34.4	17 26.5	16 25	8 12.5	1 1.6	64 %
Nationality	33 51.6	18 28.1	9 14.1	2 3.1	2 3.1	64 %

It is worth stating that some contractors emphasised the importance of 'prior business relationship'. Through prior relationships, contractors have more confidence in the client, and can collaborate more easily with clients and their representatives in a proactive approach to solving problems. On the other hand, clients are familiar with the contractor's team and their expertise and are reassured by their experience of similar projects. Clients also have confidence in what the contractor can deliver in terms of cost, programme and quality.

Price was the dominant factor, especially where pre-qualification is a separate exercise. In such a situation, the importance of the other factors becomes hidden. One explanation for this is that the other factors may have been considered already during the pre-qualification stage. This reduces the possibility of basing the final decision of awarding the contract on subjective factors by the client. In general, the lowest tender is accepted, but the client does not bind himself to accept the lowest tender. Therefore, even the low price is the most determining factor in winning the contract at the tendering stage, other factors such as company's reputation, financial standing, early completion and prior working relationships should not be neglected. These are the fundamental factors in establishing partnership relationships in the future, and in obtaining work more from repeating clients, although these influencial factors become hidden at this stage.

8.5.2. The Negotiation Sub-stage

Table 8.36. found that 34.2% (26 out of 76) of the contracts were obtained through both competitive bidding and negotiation (two-stage tendering), and 11.8% (9 out of 76) of the contracts were obtained through negotiation. The term 'negotiation' implies such contracts are arrived at through discussions between the client and a contractor. If discussions fail or break down, negotiations will be opened with the tenderer who has submitted the next most favourable tender - and so on (Williams, 1992). The heavy dependence on the use of two-stage tendering and negotiation has placed a great deal of emphasis on the role of the contractor as a negotiator.

It is reasonable to expect that these contractors had prepared themselves for negotiations needed to win the contract in the first instance. It would then be useful to find out what preparations for negotiations were made, and the factors emphasised during their preparation for negotiation.

Respondents were to base their answers on only one of the contracts they had completed during 1991 - 1993. However, some respondents answered the questions on negotiation, even though their contracts were obtained through competitive bidding without negotiations. Some of these indicated clearly that their answers were based on their experiences on other contracts, but others did not. A detailed examination of these answers shows it is reasonable to assume that these answers were also based on the respondents' prior experiences. These answers can be used for analysis without affecting the validity of the result. All the answers were used in data analysis regardless of the contracts on which they were based.

Table 8.46. describes the size of the negotiation team. The result shows that 70.3% (45 out of 64) of the responding companies have a negotiation team of between two and four (2 - 4) negotiators, 9.4% of the companies have more than four negotiators, and 20.3% of the companies have only one negotiator. Twelve (12) companies that obtained contracts through competitive tendering did not answer this question.

Table 8.47. identifies the expertise of the negotiation team members. The negotiator's characteristics were diverse, most of them have been classified into broad four sectors and presented in Table 8.47. in order of their importance which emphasised by responding companies.

Table 8.46. Size of the Negotiation Team

Negotiator	N	%
One	13	20.3
Two	12	18.8
Three	18	28.1
Four	15	23.4
More than four	6	9.4
Total	64	100.0

Table 8.47. Characters of the Negotiation Team Members

Sectors	Areas Covered
Commercial	Price, delivery, commercial policy on risk taking
Technical	Specification, programme, methods of work
Legal	Contract documents, terms of contract, insurance, legal interpretation
Financial	Terms of payment, credit insurance, bonds and financial guarantees

The table shows that the commercial background of the negotiator, which covered the areas of price, delivery, and commercial policy on risk taking, was considered the most important characteristic for the negotiator. This implies that price is most important in negotiations too. Construction companies not only want to win contracts, but also to achieve profits through a satisfactory price. In other words, the objective of negotiations is usually to gain some expected return on sales, taking into account the risks involved, at a price acceptable to the client.

Given the importance and potential risks of using inexperienced or unskilled negotiators, a company is likely to require specialised skills or services. If other people are needed on negotiation teams, they should receive the necessary training in negotiation.

Tables 8.48. and 8.49. illustrate whether members of the negotiation team received necessary training before they were selected, and how well they were able to prepare for negotiations following the bid. The responses show that 20.3% of the negotiation teams received a great deal of training before they were selected, and other 68.8% of the negotiation teams received some training. Only seven companies (10.9%) did not train members of their negotiation teams. A number of these companies emphasised their negotiators experience and their belief that the negotiators did not need any special or further training.

Table 8.49. shows that all companies prepared for subsequent negotiations after they had submitted their bids. Most (90.6%) indicated that they were well prepared before the commencement of the negotiation.

Table 8.48. Training of the Negotiation Team

Extent	N	%
Not at all	7	10.9
A little	9	14.1
Some	15	23.4
Quite a bit	20	31.3
A great deal	13	20.3
Total	64	100.0

Table 8.49. Preparation for Negotiation

Level	N	%
Modestly	6	9.4
Quite well	34	53.1
Very well	24	37.5
Total	64	100.0

Table 8.50. shows that there is a positive relationship between the risk perception and the preparation for negotiation (chi-square = 6.484), and the relationship is significant at 95% level of confidence. These findings have supported hypothesis H3d that contractors prepare for negotiation as a risk management method. There is a positive relationship between the perception of risk and the level of preparation for negotiation.

Table 8.50.
Contingency Table for Risk Perception
and Negotiation Preparation

Perceived Risk		Negotiation Preparation Modestly	Quite Well	Very Well	Total
No	O:	4	8	4	16
	E:	1.5	8.5	6.0	16.0
Yes	O:	2	26	20	48
	E:	4.5	25.5	18.0	48.0
Total	O:	6	34	24	64

O: Observed E: expected
Chi-square=6.484 with D.F.=2

Table 8.51. shows the factors which construction companies emphasised in preparing for negotiations. More than half of the responding companies (53.2%) most

emphasised pointing out the advantages of buying from the company, such as cost saving, performance, and management ability. Some of the companies (28.2%) most emphasised identification of the parts which the client is unlikely to accept, and readiness to offer the client cost effective alternatives. Some of the companies also concentrated on competitive issues such as finding the client's strengths and weaknesses relevant to the negotiation, as well as identifying their opponents. From above results, the preparation for the negotiation has carried out by construction company.

Table 8.51.
Factors Emphasised in Preparing for Negotiation

	Emphasis Least <-----------> Most					
Factors	1	2	3	4	5	N
The advantage of the company	1 1.6	1 1.6	10 16.1	17 27.5	33 53.2	62 %
The parts unacceptable to the client	4 6.7	7 11.7	13 21.7	19 31.7	17 28.2	60 %
The client's strengths and weaknesses	6 9.7	8 12.9	14 22.6	28 45.1	6 9.7	62 %
Competitor's strengths and weaknesses	5 8.2	8 13.1	17 27.9	20 32.8	11 18.0	61 %
Identifying the opponent	1 1.6	16 25.8	21 33.9	16 25.8	8 12.9	62 %

Tables 8.52. shows the effects of background similarity on negotiation. The results show that 88.9% (56 out of 63) of the negotiation teams of the responding companies had similar training or educational background as their opponents in the clients' organisations. Among them, 49 companies (87.5%) thought that negotiations were made easier because the negotiators had similar

background. Only 7 companies (12.5%) thought that there was no apparent effect on negotiations. The results also show that 40% (2 out of 5) of the companies thought the negotiations were prolonged when the backgrounds of the negotiation teams were different.

Table 8.52.
Effect of Negotiators' Background on Negotiations

Background	Negotiation Effect Prolonged	No Effect	Easier	Total
Not the same	*2(40)	3(60)	0	**5 [8.0]
Similar	0	7(12.5)	49(87.5)	56 [88.9]
The same	0	0	2(100%)	2 [3.1]
Total	2	10	51	63 [100%]

* (%): Row Percentage ** [%]: Column Percentage

The result of an analysis to determine the relationship of these two variables is presented in Table 8.53. The data suggests that there is a positive relationship between the 'easiness' of the negotiation and the 'sameness' of negotiators' background, and the relationship is significant at 99% level of confidence. These findings have supported hypothesis H3e that similarity in the negotiators' background eases negotiations and reduces risk.

Table 8.53.
The Relationship between Negotiation Easiness and Negotiator's Background

Statistics	Value	Significance	D.F.
Chi-square	34.4863	0.0000	4
Kendall's tau-b	0.5615	0.0000	

Similar backgrounds allow improved communication and understanding. Negotiators may communicate with each other more easily and better understand the potential risks, and better appreciate what each will tolerate, and even know better the bluffing tactics used. All this make it easier for them to compromise or reach mutually satisfactory conclusions. In other words, it is easier for both parties to achieve their negotiation objectives - win the contract on acceptable and achievable terms.

While contract price remains important in competitive tendering, however, more stress will be placed on negotiation. Skill in negotiation makes it possible to alter clients' perceptions and preferences. There can be little doubt that changes in procurement, in particular the long term, 'partnership sourcing' movement, will produce an ongoing need for greater skills in the area of negotiation.

Negotiation is a process both of reaching an agreement and of building up personal relationships. Perceiving the risk of losing the contract, contractors use the presentation of a well trained and prepared negotiation team as a risk management method to cope with the risk perceived. In addition, the presentation by the contractor's negotiation team (non-price competitive in which the company's expertise and experience are stressed) also plays an important role in assuring the continuing business relationships.

8.5.3. The Commitment Stage

For the contractor, the real beginning of the project is the day they go to work on the site of the new construction project. Chapter Six demonstrated that the execution of a construction project involves many inputs or factors, and is fraught with many sources of risk with a wide range of technical and management problems to be solved.

Tables 8.54. and 8.55. are based on the answers respondents gave when asked to indicate which contract stages was perceived as most risky, and the reasons for their choice. Table 8.54. shows that 58.6% (44 out of 75) perceived the contract commitment stage as being the most risky and 28% (21 out of 75) of the companies considered the tendering stage as the most risky one.

The risk faced at the tendering stage was that of submitting a poor bid. Because the outcome of tendering was unknown and allowed no second chance, if the tender price was not calculated correctly there was no redress. Risks increased during the commitment stage because of the number of factors involved. Some risks were totally beyond the control of the construction company. Although assumptions about unknown or uncertain factors were made at tendering stage, their effect could not be assessed until work was in progress. In other words, once execution was started companies were committed and their performance must match their obligations. This generally explained why most construction companies perceived the commitment stage as being the most risky stage in the process of obtaining and executing a construction project.

Table 8.54. The Most Risky Stage of Construction Project

Stages	N	%
Commitment stage	44	58.6
Tendering stage	21	28.0
Design/Specification stage	5	6.7
Negotiation stage	3	4.0
Pretendering stage	2	2.7
Total	75	100.0

Table 8.55. is based on the answers of the 44 responding companies which perceived the commitment stage as most risky. Although most of the responding companies (40.9%) thought that there were too many variables that could affect the companies' performance the main contributors consisted of labour (both contractor and subcontractor's workforce), materials, plant and equipment, cash flow, poject programme, and coordination between the contractor's management team and the client's representatives, etc. All these are management-related factors. If any goes wrong at this stage, it could cause a loss to the contractor, and sometimes even a financial disaster.

Table 8.55.
Reasons for Commitment Stage as Most Risky (Total N=44)

Reasons	N	%
Too many variables affecting performance	18	40.9
Risks realised when executing the work	13	29.5
Site management problem	*8	18.2
Subcontractor and supplier performance	6	13.6
Possible design changes	5	11.4
Unpredictable weather and ground condition	5	11.4
Cost occurred when work in progress	4	9.1

* To be read: 18.2% (8 out of 44) of the responding companies perceived commitment stage as most risky because unforeseen site management problems which may arise during this stage.

Five (5) companies thought that the possibility of inadequate design or design changes at commitment stage made it most risky. This suggests that design changes could seriously disrupt projects and attract the attention of the responding companies. This is consistent with the results shown in Tables 8.28. and 8.29. Another factor which deserves comment are the 'risks realised when executing the work'. The table showed that 29.5% (13 out of 44) of the responding companies perceived the commitment stage as most risky because of these risks. This was associated with the company's ability to assess or estimate risks correctly in the tendering stage.

However, in the tendering stage, even the company that submitted a well formed bid price did not always assess risks correctly. The risk assessments on which the bid was based, were justified only when they were borne out by the reality in the contract commitment stage.

This is also consistent with the findings of Section 8.4., that is - most construction companies do not apply rigorous risk analysis techniques in their preparation and the submission of bids. Because of a lack of quantitative risk analysis techniques, risk is often dealt with in an arbitrary way, simply adding a certain amount of 'contingency' onto the estimated cost of a project. It is no wonder most companies perceived the commitment stage as being most risky, because they were afraid of the risks they had not identified before executing the construction work.

The possibility of not being able to complete the construction project on time was perceived as risk by most companies (see Table 8.20.). Completion of a construction project on time is a function of several things, among them: the productivity of the workforce and effective management of materials. The failure to manage workforce and materials effectively may result in serious delay or stoppage of construction work.

Table 8.56. is based responses given to a question on whether they experienced serious delay. If so, then Table 8.57. investigated the importance of the factors considered as contributing to the delay.

Table 8.56.
Delay/Stoppage of Work Experienced by Contractors

Delay/Stoppage	N	%
Yes	39	51.3
No	37	48.7
Total	76	100.0

Table 8.57.
Factors which Cause the Delay/Stoppage of Work

	Importance Least <---------> Most			
Factors	(1-2)	3	(4-5)	N
Design problems	4 12.5	4 12.5	24 75	32 %
Subcontractor performance	8 25.8	9 29.0	14 45.2	31 %
Weather/Physical conditions	14 48.3	4 13.8	11 37.9	29 %
Material problems	15 62.5	3 12.5	6 25.0	24 %
Public utilities	16 61.5	4 15.4	6 23.1	26 %
Lack of know-how	18 81.8	3 13.6	1 4.6	22 %
Cash flow problems	19 95.0	1 5.0	0 0.0	20 %

The result in Table 8.56. shows that more than half of the contractors (51.3%) experienced delay or stoppage of work during the time of construction. Table 8.57. shows that the major causes include design variation or inadequate design, poor subcontractor performance, poor weather or physical conditions, shortage of required materials, and shortage of public utilities.

The successful completion of a construction project on time raises a wide range of management problems. A failure to manage can become a major source of risk at the commitment stage. Table 8.58. is based on rating of the critical factors in the successful execution of the construction contracts. It shows that most of the responding companies considered the relationship between the client's representatives and the construction company (50%), the internal coordination within the construction company itself (38.7%), and the relationship between the client and the company (34.2%) as being most important factors for a successful execution of their contracts.

The execution of construction work involves many skills and different interests, once the work on site has begun a great variety of internal and external factors will affect its success. Overall coordinating management is needed to ensure that each participant links their activities with those of the others, so as to keep to programme and budget. Although the client, his representatives and the construction company may be considered opposing parties to a contract, they must work together as a team in order to the ends for which the contract is merely a means. This explains why most companies recognised the overall coordinating management and their internal management control as vital to the success of the project, thus supporting hypothesis H4a (chi-square=11.863, 0.05 level of significance). This perspective also explains why poor coordination between contractor and architect/engineer was a risk (see Table 8.20.). Generally, it seems that the more involved are client's personnel with a project, the greater is their satisfaction with the level of project performance achieved, that is personal involvement enhances a person's perception of the performance achieved (Langford et al, 1995). So, it is good expressive performance which is vital and conducive to the forging of good and continuing business relationships. All contractors must realise this and do their best to establish long term and integrated partnership relationships between them and their clients.

Table 8.58.
Factors which Affect the Execution of Construction Work

	Importance Least <-----------> Most					
Factors	1	2	3	4	5	N
Relationship between client's representative and company	0 0.0	3 4.0	8 10.5	27 35.5	38 50.0	76 %
Internal coordination within the company	2 2.7	4 5.3	13 17.3	27 36.0	29 38.7	75 %
Relationship between client and company	4 5.5	4 5.5	13 17.8	27 37.0	25 34.2	73 %
Site labour management	2 2.6	4 5.3	15 19.7	30 39.5	25 32.9	76 %
Subcontractor performance	3 4.1	1 1.4	16 21.9	29 39.7	24 32.9	73 %
Contract price	6 8.0	15 20.0	21 28.0	15 20.0	18 24.0	75 %
Prompt payment for work done	5 6.8	8 10.8	21 28.4	26 35.1	14 18.9	74 %
Technological know-how	1 1.4	8 10.8	27 36.5	24 32.4	14 18.9	74 %
Materials management	1 1.3	4 5.3	31 41.4	27 36.0	12 16.0	75 %
Weather conditions	8 10.8	14 18.9	23 31.1	18 24.3	11 14.9	74 %
Financial status of company	17 23.3	14 19.2	18 24.6	17 23.3	7 9.6	73 %

Effective management of site workforce (32.9%) and subcontractor's performance (32.9%) were also considered as being most important for the success of a project, thus supporting hypothesis H4b (chi-square=10.238, 0.05 level of significance). However, only 16% of the responding companies considered materials management as being most important (chi-square=4.847<0.90). This may be attributed to materials management being effectively handled or managed by most construction companies after practice for years. Therefore the importance of materials management has been relatively less emphasised. This result makes hypothesis H4c not so significant.

Only 24% of the responding companies considered the contract price as being most critical for a successful execution of a contract. This findings is not necessarily contrary to the discussion in Chapter Five about the risk implications of submitting a underestimated price, or contrary to the findings in Table 8.20. that 'no profit' was perceived as risk too.

It means that while a fair bid, based on reliable risk analysis or accurate estimates, provides adequate financial contribution to the successful execution of the contract, the overall effect depends on the first five factors identified in Table 8.58.

It should be clear that a successful construction project relies not just on sound technical input, but also on project and business skills, such as planning, estimating, monitoring, control, coordinating and managing. The way to ensure success is to apply sufficient and effective management in reducing risk, especially in the commitment stage.

Table 8.59. describes project success. The data is based on responses to a request on rating success in achieving: profit, completion date, quality, industrial relation, claim settlement, managing functioning and total performance. The results show that, in total performance, 21.4% of the contracts were rated very successful, and another 58.9% of the contracts were rated

successful (scale 5-6) when they were finished. Only 20% were dissatisfied with their overall performance. The results of analyses reveal that responding company has exerted different management functions in reducing risk in the commitment stage in executing a project for the benefit of the company. These results are based only on the construction companies' answers. Their clients might not give the same ratings to these projects.

Most of the projects were successfully completed. This success depended on the effectiveness of management in the commitment stage. Further statistical evidence of the relationships between the successful execution of contracts and the affecting factors in Table 8.58. is presented in Table 8.60.

Table 8.59. Construcion Contract Success

Aspect	Very unsuccessful 1	2-3	4	5-6	7 Very successful	N
Profit	3 4.0	16 21.6	21 28.4	19 25.7	15 20.3	74 %
Completion date	1 1.3	9 12.0	11 14.7	26 34.7	28 37.3	75 %
Product quality	0 0.0	0 0.0	5 6.6	47 61.8	24 31.6	76 %
Industrial relation	0 0.0	4 5.4	11 14.9	38 51.3	21 28.4	74 %
Claim settlement	3 4.5	7 10.4	18 26.9	27 40.3	12 17.9	67 %
Managing functioning	0 0.0	3 4.3	14 19.7	37 52.1	17 23.9	71 %
Total performance	1 1.8	4 7.2	6 10.7	33 58.9	12 21.4	56 %

Table 8.60.
The Relationship between Project Success and Some Factors

Factors	Chi-square	Significance
Coordinating management	*11.863	0.0184
Internal coordination	*11.433	0.0221
Relationship with client	*11.217	0.0242
Site labour management	*10.238	0.0366
Subcontractor management	*9.674	0.0463
Contract price	**8.027	0.0906
Prompt payment	4.256	0.3725
Technological know-how	4.742	0.3148
Materials management	4.847	0.3034
Weather conditions	3.538	0.4721
Financial Status	3.799	0.4339

* Critical value (5%)=9.49 with D.F.=4
** Critical value (10%)=7.78 with D.F.=4

8.5.4. Section Conclusion

From the evidence presented in this section, there is no doubt that the tendering stage is considered the most important stage in the contracting process.

The data show that most companies searched for and used information as part of their risk management strategy in dealing with risks perceived during the tendering/negotiation stage. The results also show that most companies employed a strategy of submitting a bid that would win the contract rather than simply maximise profit. Profit maximising bids would most likely reduce their chances of winning the contracts, and were thought counter productive as a consequence.

On the whole, the results show that the tendering stage offers opportunities to apply risk management through effective bidding and negotiating. This can create advantage for the company. In this regard, the findings have supported the hypothesis H3 that the tendering stage is the most important phase for applying risk management through an effective bidding/negotiating approach.

The results also show that the factors involved make the construction commitment stage the most risky stage in the process of executing the construction project. However, most respondents' projects were successfully completed. This successful execution of projects depended to a large extent on how effectively the factors involved were managed by the companies. An inability to manage became a major source of risk in this stage. Therefore, these findings have supported the hypothesis H4 that the successful execution of the construction work largely depends on the contractor's resources and management ability. Hence 'management risk' is the main risk in the contract commitment stage.

CHAPTER NINE: CONCLUSIONS

9.1. SUMMARY OF THE FINDINGS

The objective of this study was to establish how construction companies interpret or perceive risks in making decisions, and to investigate their use of risk management in different stages in contracting. Four hypotheses were formulated. The hypotheses were examined through a structured mail questionnaire, and the survey data analysed. The findings show that all the hypotheses have been supported and will be summarised.

9.1.1. Factors Affecting Risk Perception

Most contractors (76.3%) perceived risks and the following factors found to influence their perceptions of risk.

Project (Contract) Value

The larger the project/contract value, the greater the number of contractors that perceive risk (chi-square=12.729, 0.01 level of significance). The relationship is positive.

Company Size

The larger the size of the contractor, measured by its annual sales turnover, the more likely it is to perceive risk (chi-square=6.750, 0.05 level of significance). There is a high degree of association between the company size and risk perception, although company size is important there are other primary determinants.

Types of Construction Projects

The nature of the project is significant. Civil engineering works are perceived by contractors as involving higher risk than building works (chi-square=6.654, 0.01 level of significance).

Client's Knowledge of His Needs

The client's knowledge of his needs is inversely related to the risk perception by contractors (chi-square=3.004, 0.1 level of significance). This finding is closely related to the following facts:

First, most construction designs (76.3%) were changed before the projects were completed.

Second, more than eighty percent (84.5%) of all the changes were initiated by the clients.

Third, 'changes in the needs of the client or the user' was responsible for more than forty percent (41.7%) of all the variations in the construction designs. Other reasons for design changes were 'faulty design or unclear early design', 'reducing production cost', and 'improving product performance'.

This suggests that the inverse relationship between risk perception by contractors and the extent that the client knew his needs, was due to the more knowledgeable client providing adequate and accurate information with reduced chances of design variations.

Types of contracts

Price-based contracts, such as lump sum and admeasurement, have considerable influence on risk perception by contractors relative to cost-based contracts, such as cost-reimbursable and target cost.

Types of Clauses

The wording of the contract may become a risk factor for a contractor, especially when clauses allowing liquidated damages and retention are included.

Several factors were found to have no significant influence on the perception of risk.

Managerial Position

In general, the managerial positions of the respondents do not have any appreciable influence on the perception of risk (chi-square=4.138<0.90).

Standard/Non-standard Form

The risk perception of contractors using a standard form of contract was not significantly different from those using a non-standard form of contract (chi-square=1.108<0.90).

9.1.2. Types of Risks Perceived

The contractors perceived the following types of risks in their decision making process.

* The possibility of not being able to complete the project on time.
* The likelihood of not making any profit.
* The possibility of not producing a satisfactory product.
* The possibility of not finding a client who would make a good team.
* Poor performance of sub-contractor and supplier.
* Inclement weather.
* Low productivity on site operation.
* Poor labour relations.
* Client's financial instability.
* Material cost inflation.
* Poor foundation condition.
* Strict contract condition.
* Fail to get tender.
* The needs of the client may change before the project is completed (The possibility of variations in a design).

The possibility of not being able to complete the construction project on time, not making any profit, and not producing a satisfactory product were perceived more risky than other risk factors. Time, cost and quality are inextricably linked in any construction project. These are 'umbrella' risks that catch a wide variety of contributory problems. Failure on the part of the contractor to complete the project on time, or to produce satisfactorily may result in damages.

9.1.3. Methods Employed to Manage Risk

Since the nature and types of the risks contractors perceived varied widely the methods they adopted to manage these risks also varied. The main risk management methods used by contractors to manage risks were:

* Careful planning of the project.
* Careful monitoring of progress.
* Effective labour force management.
* Sub-contractor and supplier selection.
* Close communication with the client and his advisers.
* Procuring sensitive materials early.
* Double checking key rates and preliminaries before submitting the bid.
* Renegotiate key points if the client makes changes.
* Preparation before negotiations.
* Reasonable contingency allowances.
* Proper provision for risk.
* Ready and willing to reschedule areas of work as problems arise.
* Careful drafting the contract.
* Improving the know-how.
* Using a reliable, standard form of contract.

Most companies managed the risk by 'careful planning' and 'careful monitoring the progress'. Since most construction projects are given to contractors as a result of a competitive tendering procedure it is vital for contractors to plan their activities carefully before tendering for a contract. They must set down a realistic programme for carrying out the work. Monitoring project progress is a control issue. Control is the process of measuring the actual progress against these plans or standards and adjusting the use of resources to meet deviations from the original intentions. If plans and control are effective, risks can be managed and successful construction can be achieved so that all parties profit.

9.1.4. The Use of Risk Analysis Techniques

A review of the use of risk analysis techniques, such as Sensitivity Analysis, Probability Analysis, Decision Tree Analysis, etc., has shown that only four (4) of the seventy six (76) responding companies used sensitivity analysis, and only two (2) companies used probability analysis. Obviously, rigorous risk analysis techniques were not widely applied in the construction industry for risk management.

Failure to use these risk analysis techniques, in general, can be attributed to the following arguments:

* Lack of awareness: The contractor is unfamiliar with risk analysis and unware of its potential contribution.
* Lack of expertise: The contractor lacks the resources to carry out risk analysis.
* It is unnecessary: The contractor considers that a formal detailed, quantitative analysis is not needed.
* Lack of time: The contractor takes the view that there is not enough time to carry out risk analysis within the specified deadlines.
* Difficult-to-quantify risks: The contractor perceives that risks are too difficult to quantify.

Although most contractors (92.1%) do not use quantitative risk analysis techniques to manage the risks of projects, they do use qualitative risk analysis. Three techniques commonly used are:

* Check lists of risks compiled from previous experience.
* Interviews with key project participants.
* Brain-storming with the project team.

The results showed that the more traditional techniques are still favoured by contractors. The analysis of the results also revealed that most contractors do not have a Risk Department in concerning the risk analysis. Most contractors have a Estimating Department responsible for preparing the estimate and any risk analysis. At present, information about contract risk usually comes through the Estimating Department. Several weaknesses of the present risk analysis procedures were identified:

* A tendency to double-count risks.
* The risk is dealt with in an arbitrary way.
* Risk tends to be considered only in terms of a cost contingency, this directs attention away from time, performance and other risks.

Contractors new to risk analysis techniques may start by first establishing a risk management team, rather than a risk management department. Risk analysis could then be carried out by those trained to do so with cost estimators and project planners until confidence is gained.

9.1.5. The Tendering Stage

The analysis of the survey on the tendering stage and the strategies adopted by contractors found:

Construction contracts were generally obtained through competitive tender (54.0%), and most of these through selective competitive tender (30.3%). The preferred mechanism for letting contracts is the traditional competitive two-stage tender (34.2%).

Most contractors (54.1%) and respondents (49.3%) became involved in the projects only when tenders were invited.

Most contractors (81.6%) searched for and used information as a risk management strategy before submitting bids. This was especially the case when the contractors perceived risks. The contractors' undertaking of investigation has shown significant association with their risk perception (chi-square=3.490, 0.1 level of significance). Contractors undertook their own investigations for the following reasons:

* To find out potential risks in contract conditions (83.9%).
* To obtain more information to improve bid acceptability (75.8%).
* To verify the accuracy or validity of the information supplied by the client (62.9%).
* To investigate possible design alternatives (50.0%).
* To find the client's actual needs (40.3%).
* To obtain specific local advice on the site (38.7%).

Most contractors (86.8%) based their bids on both the tender documents supplied by the client, and their own investigations.

Most contractors (78.9%) identified the assessors of their bids before they were submitted. Consequently, seventy seven percent (77.0%) of the bids took the assessors' characteristics into consideration.

Most contractors (70.0%) based their bid price on a small margin of profit and contingency for risks.

Most contractors (56.7%) considered price as the most important factor in their winning of contracts. Other influential factors were:

* Company's reputation
* Company's good financial standing
* Early completion date

* Prior relationships
* Negotiation skill
* Industrial relations
* Company's proximity
* Selling tactics

The bid price constituted the determining factor, particularly where pre-qualification was a separate exercise. In such a situation, the importance of the other factors became hidden.

However, factors such as company's reputation, financial standing, early completion and prior working relationships should not be neglected. These are the fundamental factors in establishing partnership relationships in the future, and in obtaining work more from repeating clients.

9.1.6. The Negotiation Sub-stage

More than thirty percent (34.2%) of the contracts were obtained through both competitive tender and negotiation (two-stage tendering) while only 11.8% of the contracts were obtained through negotiation.

Most contractors (70.3%) used a negotiation team comprised of 2 to 4 negotiators. The commercial expertise of the negotiator, which covered the areas of price, delivery, and commercial policy on risk taking, was considered most important for the negotiator.

Most contractors (75.0%) provided the necessary training to their negotiation teams before they were selected.

Most contractors (90.6%) considered themselves to be well prepared before the commencement of any negotiations. Contractors prepare for negotiation as a risk management method. Study found a positive relationship between the perception of risk and the level of preparation for negotiation (chi-square=6.484, 0.05 level of significance).

During the preparation for negotiation, most contractors (53.2%) emphasised their competitive advantages. However, some contractors (28.2%) focussed on identifying areas of weakness and prepared to offer cost effective alternatives.

Study found a positive relationship between the 'easiness' of negotiation and the 'sameness' of negotiators' training or educational background (chi-square=34.486, 0.01 level of significance). Similarity in the negotiators' background eases negotiations and reduces risk. Because of this, some contractors (38.7%) emphasised the need to identify the negotiators for the client's organisation.

There can be little doubt that changes in procurement will produce an ongoing need for greater skills in the area of negotiation. The presentation by the contractor's negotiation team (non-price competitive) will play an important role in assuring the continuing business relationships.

9.1.7. The Commitment Stage

The analysis of the survey results on the contract commitment stage found that most contractors (58.6%) perceived the contract commitment stage as being the most risky stage. This was because it involved many sources of risk, such as:

* The management of labour workforce, materials, plant and equipment, cash flow, and project programme.
* Coordination between the contractor's management team and the client's representatives.
* Possible design changes.
* Unpredictable weather and ground condition.

Most of these are management-related factors. If any problems arise at this stage, the usual result is a delay on the project.

In fact, half of the contractors (51.3%) experienced some delay or stoppage of work. The major causes included design variations, poor subcontractor performance, shortages of required materials, and a lack of know-how.

Nevertheless, most of the contracts (80.3%) were considered to be successful. The success was found to depend largely on the following factors:

* Coordination with the client's consultants (chi-square=11.863, 0.05 level of significance)
* Internal coordition within the contractor's company (chi-square=11.433, 0.05 level of significance)
* Relationship between client and company (chi-square=11.217, 0.05 level of significance)
* Site labour management (chi-square=10.238, 0.05 level of significance)
* Subcontractor performance (chi-square=9.674, 0.05 level of significance)
* Contract price (chi-square=8.027, 0.1 level of significance)
* Prompt payment for work done (not significant)
* Technological know-how (not significant)
* Materials management (not significant)

Obviously, the way to ensure success is to provide sufficient and effective resources management in the commitment stage. A failure to manage becomes a major risk at this stage.

9.2. CRITIQUES OF THE STUDY

Three criticisms may be made against this study. The first relates to the exclusion of clients from the sample. The client plays an essential part in construction process and without considering their views some findings of this study may not be fully reliable or representative.

Both economic and time constraints limited this study. The question of not including the client in the sample is one of a number of problems therefore raised. Also both the need for the contractors to maintain confidentiality of their clients and the need for the clients to maintain confidentiality are unlikely to get enough responses. The 36.2% usable response rate is good, but if only one third of their customers cooperate, this only yields a 10% response rate from the clients and an insufficient number of clients for statistical analysis.

Other research studies have been undertaken on perception and management of risk by individual consumers and organisation buyers. The client, as a buyer in the construction industry, can reasonably be expected to have the same characteristics as other buyers. Therefore, when the views of the buyer - client were needed, the earlier research findings about industrial buying behaviour were adopted to represent established points of view.

The second criticism is concerned with the conceptualisation and design of the research. The study may be criticised for attempting to cover all the decision making phases and failure to focus on one particular stage in greater detail.

A standard construction contract evolves through different stages such as the precipitation stage, the design stage, the tendering stage, and the commitment stage, each with its own risks. This study was conceptualised as looking at the perception and management of risk by contractors in all the stages. This loss of focus on one particular decision stage, for example the tendering stage, as opposed to all the critical decision stage, was justified on the grounds that a contract is not considered successfully concluded until the project is completed, or delivered. Although the tendering stage is very important, a narrow focus on some of the stages would not provide the overall picture of how construction companies perceive and manage risks during a project.

The third criticism relates to the types of construction projects included in the study. Different types of construction projects present different problems. This study by lumping all types of projects together, loses perspective on the peculiar problems which may be associated with certain types of projects. Some of the conclusions of the study are then 'non-specific'.

Although the unique nature of construction projects was recognised, their unique elements are important than the common factors. This is especially true in the offshore construction works. However, in the ordinary building and civil engineering areas, that were the focus of this study, the industrial forms of work and decision process handled are very old established indeed, including traditional procedures and practices at all levels. The results of the survey analysis show that almost all of the projects (96%) based on this study were building and civil engineering projects. These projects were similar in their work forms and decision process. In fact, by careful examining the answers of the respondents, we found the homogeneous nature of these projects rather than their uniqueness. The overall evidence shows that the inclusion of different types of construction projects was justified.

These explanations not only show the author was aware of above criticisms, but also show these criticisms had been effectively dealt with.

9.3. ASSESSMENT OF CONTRIBUTIONS

The important contribution of this study is it draws together previously unrelated streams of research and shows how they provide the foundation for a more complete analysis. This study describes how contractors manage perceived risks in their contract decision making process. Moreover, the results of the study should help improve the practice of risk management for three reasons.

First, the study demonstrated that not only buyers perceive risk, but also sellers - the contractors in the industry. A catalogue of different types of risks perceived by contractors was presented based upon their experience.

Second, alternative methods that may be used to manage perceived risk are presented.

Third, the various factors considered to affect the successful execution of a contract were identified.

Therefore, the analysis presented advances the understanding of risk management for contractors, and provides some important insights to help in developing a better understanding of the management in the construction industry.

9.4. SUGGESTIONS FOR FURTHER RESEARCH

The interaction of the risk perception and management in dealing with construction contracts between contractors and clients is a complex process. We could not examine the many plausible interaction effects on risk perception between contractors and clients because of time and cost limitations. Further research is suggested to extend the ideas proposed here, thus adding complexity and richness to the understanding of perception and management of risk in the construction industry by studying contractors and clients together.

The findings suggest that the relationship between risk perception and the size of the contractor and project is not linear. In other words, the value of the contract and the size of the contractor do not necessarily increase or decrease a contractor's perception of risk on that contract. Further research in this area should include both individual and situational factors so that the causes and their effects may be identified.

Generally, it was found that quantitative risk analysis techniques were not applied. As such, most contractors did not have Risk Department to administer the risk analysis. In view of the potential role which risk analysis can play in aiding the management of construction projects further research is needed to discover how the present situation can be improved to make risk management more effective and acceptable in the industry.

APPENDIX A:

RESEARCH SUPERVISOR'S SUPPORTIVE LETTER

UNIVERSITY
of
GLASGOW

Our Ref: JMW/AM

12 August 1993

Mr P. Shepherd
Shepherd Construction Ltd
Frederick House
Fulford Road
York YO1 4EA

Dear Mr Shepherd,

I am supervising research in Risk Management and Contractual Negotiations in the Construction Industry and would appreciate it if you, or an appropriate project manager, could provide some information to us. All responses will be kept confidential and you will be supplied with copies of any interim and final reports.

I do hope that you will be able to assist us in this study. Should you have any questions please contact me.

Yours sincerely,

Dr James M. Wilson

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APPENDIX B: THE QUESTIONNAIRE

ABSTRACT OF THE QUESTIONNAIRE

Many past studies of construction management and contract management have been undertaken. Most of these studies scrutinise the problems in view of the client rather than the contractor, and most dealt with how construction work was managed as an engineering project rather than a managerial decision making process.

Also a considerable amount of research studies has been done on perception and management of risk by decision makers. However, we observed that previous research has been concerned mainly with individual decision makers in consumer buying involving relatively small value transactions. Virtually all are concerned with buyers. Contractors as sellers in the construction business transaction can also be at risk in their contracting process.

The purpose of this research is to investigate how construction companies apply their risk management strategies in contracting process. Accordingly, the objectives of this questionnaire are as follows:

1. To find out the types of the risks perceived by construction companies in their contract decision making process.

2. To find out the factors which affect the risk perception.

3. To find out how risk analysis techniques are used in contracting process.

4. To find out how the wording of the contract legally protects the company from certain types of risks.

5. To find out the risk management strategies employed in pre-tendering stage and tender stage.

6. To find out the efforts the company have made concerning the negotiation stage.

7. To find out the risk management problems which the company may have encountered during the commitment stage.

Please answer the questions, unless otherwise stated, by ticking the appropriate box.

Q1. What is the name of your company and your position in the company (If not the addressee)?

Name of the company: ______________________________

Position in the company: ______________________________

Q2. How long have you been involved in contractual decision making for projects?

- ☐ Not at all
- ☐ Less than 3 years
- ☐ 3 -- 5 years
- ☐ More than 5 years

Q3. Has your company completed a project worth more than £1,000,000 during last two years (1991 - 1993)?

- ☐ Yes
- ☐ No

N.B. If your company completed more than one project worth at least £1,000,000 during last two years, please CHOOSE ONLY ONE of the contracts on which all your answers to this questionnaire will be based.

Q4. What was the value of the contract?

- ☐ Under £1m
- ☐ £1m - £2m
- ☐ £2.1m - £4m
- ☐ £4.1m - £6m
- ☐ £6.1m - £8m
- ☐ £8.1m - £10m
- ☐ £10.1m - £20m
- ☐ £20.1m - £40m
- ☐ Over £40m

Q5. Who was the client/customer?

N.B. If you are a subcontractor, please indicate both the contractor and the actual client of the project. If you don't like to give the name of your client, please indicate the category of your client related, e.g., central government, private commercial organisation, etc.

Name of client: ______________________________

Name of contractor: ______________________________

Q6. What type of this construction project was?

- ☐ Houses
- ☐ Factories
- ☐ Commercial buildings
- ☐ Roads
- ☐ Bridges
- ☐ Canals
- ☐ Tunnels
- ☐ Harbours
- ☐ Others (Please specify)

____

Q7. What type of contract was it?

- ☐ Lump sum/Fixed price
- ☐ Admeasurement (Tender price + Variations authorised)
- ☐ Cost-reimbursable (Actual cost + Profit)
- ☐ Target cost (Target cost + Contractor's % share of cost underrun/overrun + Profit)
- ☐ Others (Please specify)

____

Q8. Which of the following clauses or conditions were included in the wording of the contract? (Tick all which apply)

- [ ] Conditions/Provisions for variations
- [ ] Liquidated damages clause
- [ ] Performance bond
- [ ] Conditions for price adjustment
- [ ] Retentions clause
- [ ] Forfeiture/Determination clause

Q9(a). Was the contract a standard form issued by various bodies such as The Joint Contracts Tribunal (JCT), The Institute of Civil Engineers (ICE), and Government etc. or was it a custom-tailored non-standard form?

- [ ] It was a standard form
- [ ] It was a non-standard form

Q9(b). What in your view was/were the main reason(s) for your company preferring to accept this standard form contract or non-standard form contract? (Please write in)

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Q10. How was the contract obtained? (Please tick one only)

- [ ] Through open competitive tender only
- [ ] Through open competitive tender followed by negotiation
- [ ] Through selective competitive tender only
- [ ] Through selective competitive tender followed by negotiation
- [ ] Through negotiation only

Q11. At what stage of the contract did you and your company become involved? (Tick one only in each column)

Y: Yourself; C: Company

	Y	C
Right from the beginning (Conceptual stage)	☐	☐
When the product was being designed	☐	☐
After the client had designed the product	☐	☐
When tenders for the contract were invited	☐	☐
After the bid was submitted	☐	/

Q12. When your company became involved, would you say that the client knew exactly what he needed? (Tick one only)

- [ ] He did not know what he needed
- [ ] He had a few ideas about what he needed
- [ ] He had some ideas about what he needed
- [ ] He knew generally what he needed
- [ ] He knew exactly what he needed

Q13(a). Did your company carry out its own investigation on the contract before submitting a bid?

- [ ] Yes
- [ ] No

Q13(b). If 'Yes', what did your company hope to find out in undertaking the investigation on the contract? (Tick all which apply)

- [ ] To verify the accuracy of the information supplied by the client.
- [ ] To identify those aspects of the product that could be eliminated from the design/specification of the product, so as to submit a low bid.
- [ ] To find out whether the information which the client provided would satisfy his actual needs.
- [ ] To find out whether any particular actions can be taken to improve bid success probability.
- [ ] To obtain specific local advice on any matters of law, taxation, important regulations etc. which could affect price.
- [ ] To find out whether the conditions of contract imposes any special risks in relation to the nature of the work to be carried out.
- [ ] Others (Please specify)

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Q14. Was the bid based on the result of the investigation or on the information contained in the tender documents? (Please tick one only)

- [ ] It was based only on the result of the investigation
- [ ] It was based primarily on the result of the investigation
- [ ] It was based equally on the results of the investigation and the information contained in the tender documents.
- [ ] It was based primarily on the information contained in the tender documents.
- [ ] It was based only on the information contained in the tender documents.

Q15(a). Did your company use risk analysis techniques such as SENSITIVITY ANALYSIS, PROBABILITY ANALYSIS, DECISION TREE ANALYSIS, etc. in its decision making process about the preparation and the submission of the bid?

- [ ] Yes
- [ ] No

Q15(b). If 'Yes', what were these risk analysis techniques used and used for? (Tick the appropriate matrix)

1: Sensitivity analysis/Probability contours
2: Probability analysis
3: Decision tree analysis
4: Bayesian analysis
5: Simulation approach
6: Game theory
7: Others (Please specify)

____

	1	2	3	4	5	6	7
Bid/No bid decision	☐	☐	☐	☐	☐	☐	☐
Profit contribution expected	☐	☐	☐	☐	☐	☐	☐
Bid price level	☐	☐	☐	☐	☐	☐	☐
Delivery to be offered	☐	☐	☐	☐	☐	☐	☐
Selecting construction method	☐	☐	☐	☐	☐	☐	☐
Others(Please specify)							
____________________	☐	☐	☐	☐	☐	☐	☐
____________________	☐	☐	☐	☐	☐	☐	☐

Q16. Who was mainly responsible for the risk analysis ? (Please tick one only)

- ☐ Production/Engineering department
- ☐ Planning department
- ☐ Finance department
- ☐ Procurement department
- ☐ Marketing department
- ☐ Others (Please specify)

____

Q17. If no formal risk analysis was undertaken, how were the major decisions such as bid/no bid, expected profit, and bid price decided? (Please tick one only)

- ☐ By general manager/executive director
- ☐ By related project manager
- ☐ By management committee

Q18. Please rate the importance of the following people in helping the decision centre to determine the bid price. (Circle the number that most closely corresponds with your view)

1:least important; 2:less important; 3:important
4:very important; 5:most important

The financial adviser	1	2	3	4	5
The accountant	1	2	3	4	5
The quantity surveyor/Estimator	1	2	3	4	5
The civil engineer	1	2	3	4	5
The production/engineering manager	1	2	3	4	5
The general manager	1	2	3	4	5
The executive director	1	2	3	4	5
Others (Please write in and rate)					
______________________________	1	2	3	4	5

Q19(a). Before the bid was submitted to the client, did your company identify who was/were likely to assess the bid in the client's firm/organisation?

- ☐ Yes
- ☐ No

Q19(b). If 'Yes', in preparing the tender, did your company take into account the background of the assessor(s) who had been identified?

- [ ] Not at all
- [ ] A little
- [ ] Some
- [ ] Quite a bit
- [ ] A great deal

Q20. On what basis did your company arrive at the bid price? (Please write in)

____

____

____

____

Q21. What was the size of the negotiation team in the follow up negotiation with the client?

- [ ] Only one negotiator
- [ ] 2 negotiators
- [ ] 3 negotiators
- [ ] 4 negotiators
- [ ] More than 4 negotiators

Q22. Did these members of negotiation team receive necessary training before they were selected?

- [ ] Not at all
- [ ] A little
- [ ] Some
- [ ] Quite a bit
- [ ] A great deal

Q23. Please rate the following points in terms of your company's emphasis during preparation for the negotiation. (Circle the number which most closely corresponds with your view)

1:least important; 2:less important; 3:important; 4:very important; 5:most important

Finding out the client's strengths and weaknesses relevant to the negotiation	1	2	3	4	5
Identifying the likely competitors and assessing their strengths and weaknesses in negotiating with the client	1	2	3	4	5
Making an effort to identify the person the company would be negotiating with	1	2	3	4	5
Pointing out the advantages of the company	1	2	3	4	5
Making an effort to identify those parts which the client is unlikely to accept	1	2	3	4	5
Others (Please write in and rate)					
______________________________	1	2	3	4	5

Q24. How well was your company prepared for the negotiation that might follow the bid?

- ☐ Very poorly
- ☐ Poor
- ☐ Modestly
- ☐ Quite well
- ☐ Very well

Q25. What was the major area covered by the negotiation team members? (Please choose TWO only and rank them in order)

1: most important; 2: important

- ☐ Commercial: price, delivery
- ☐ Technical: specification, methods of work
- ☐ Legal: contract documents, legal interpretation
- ☐ Financial: terms of payment, financial guarantees

Q26(a). Did your company's negotiator have the same training or educational background as his opponent?

- ☐ They did not have the same background
- ☐ They had similar background
- ☐ They had same background

Q26(b). What effect do you think this had on the negotiation? (Tick one only in appropriate column)

1:dissimilar background; 2:similar background
3:same background

	1	2	3
It made negotiation easier	☐	☐	☐
It prolonged the negotiation	☐	☐	☐
It made negotiation impossible	☐	☐	☐
No apparent effect	☐	☐	☐
Others (Please write in) ____________________	☐	☐	☐

Q27. Rate the extent to which you believe the following factors influenced the winning of the contract by your company. (Circle the number that most closely corresponds with your view)

1:least influential; 2:less influential;
3:influential; 4:very influential;
5:most influential

Low price	1	2	3	4	5
Early completion date	1	2	3	4	5
The skill of the negotiating team	1	2	3	4	5
Prior business Relationship with the client	1	2	3	4	5
Company's reputation	1	2	3	4	5
Company's good financial standing	1	2	3	4	5
Company's proximity to the client	1	2	3	4	5
Company's good industrial relations	1	2	3	4	5
Nationality of the company	1	2	3	4	5
Company's selling tactics	1	2	3	4	5
Others (Please write in and rate)					
________________________	1	2	3	4	5
________________________	1	2	3	4	5

Q28. What types of risk did you perceive in your decision to tender for and accept this contract? (Please write in)

____

____

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Q29. What did you do to eliminate or reduce the risk?
(Tick all which apply)

Risk avoidance/Reduction

- [ ] Redesign the risky parts of the project (if allowed by the contract documents)
- [ ] Careful drafting the contract
- [ ] Careful planning the project
- [ ] Managing labour forces effectively
- [ ] Procuring sensitive materials early
- [ ] Double checking key rates and preliminaries before submitting the bid
- [ ] Well prepared before negotiation
- [ ] Careful monitoring the progress
- [ ] Cooperation with a good team
- [ ] Improving the know-how
- [ ] Renegotiate key points if the client makes changes in the contract
- [ ] Others (please specify)

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Risk transfer

- [ ] To subcontractor
- [ ] To insurer
- [ ] To bank
- [ ] Others (Please specify)

____

Risk retention

☐ Proper provision for risk

☐ Reasonable percentage of contingency fund or risk allowance

☐ Others (Please specify)

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____

Q30(a). Did your company experience any serious delay and/or stoppage of work during the time of construction?

☐ Yes

☐ No

Q30(b). If 'Yes', please rate the following factors in terms of their contribution to the delay and/or stoppage.(Circle the number that most closely corresponds with your view)

1:least important; 2:less important; 3:important; 4:very important; 5:most important

Poor labour relations	1	2	3	4	5
Poor weather conditions	1	2	3	4	5
Shortage of required materials	1	2	3	4	5
Shortage of public utilities	1	2	3	4	5
Cash flow problems	1	2	3	4	5
Poor subcontractor performance	1	2	3	4	5
Lack of know-how in the company	1	2	3	4	5
Changes in the design	1	2	3	4	5
Others (Please write in and rate)					
____________________________	1	2	3	4	5

Q31(a). Were there any changes in the original specifications during the construction of the product after the specifications finalised?

- ☐ No changes at all
- ☐ A few changes
- ☐ Some changes
- ☐ Quite lot changes
- ☐ A great deal of changes

Q31(b). If there was any changes, was it the client that initiated the changes or was it your company?

- ☐ It was the client
- ☐ It was the company

Q31(c). If there was any changes, why was this necessay? (Please write in)

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Q31(d). Did these changes adversely affect the company's performance on the contract?

- ☐ Not at all
- ☐ A little
- ☐ Some
- ☐ Quite a bit
- ☐ A great deal

Q31(e). If there were effects caused by changes in design, could you please state briefly in what way it affected the company's performance of the project? (Please write in)

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Q32. Please rate how critical the following factors were in the execution of the contract. (Circle the number that most closely corresponds with your view)

1:least critical; 2:less critical; 3:critical; 4:very critical; 5:most critical;

The relationship between the client and the company	1	2	3	4	5
The relationship between the client's representative and the company	1	2	3	4	5
The internal coordination within the company itself	1	2	3	4	5
Site labour management	1	2	3	4	5
Materials management	1	2	3	4	5
Technological know-how of the company	1	2	3	4	5
The contract price	1	2	3	4	5
The financial position of the company	1	2	3	4	5
Prompt payment by the client for work done	1	2	3	4	5
Weather conditions	1	2	3	4	5
Sub-contractor performance	1	2	3	4	5
Others (Please write in and rate)					
______________________	1	2	3	4	5

Q33(a). Looking over the contract, which of the following stages would you say your company perceived as being the most risky? (Please tick one only)

- [ ] Pre-tendering stage
- [ ] Design/Specification stage
- [ ] Tendering stage
- [ ] Negotiation stage
- [ ] Contracting and execution stage
- [ ] Others (Please specify)

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Q33(b). Please state briefly the reasons for your choice in Q33(a).

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Q34. When this project finished , how successful would you rate this contract in following terms? (Please circle the number that most closely corresponds with your view)

1:Very unsuccessful; 4:successful; 7:Very successful

Finance (Profit achieved)	1	2	3	4	5	6	7
Completion date	1	2	3	4	5	6	7
Product quality	1	2	3	4	5	6	7
Industrial relations	1	2	3	4	5	6	7
Claims settlement	1	2	3	4	5	6	7
Managing functioning	1	2	3	4	5	6	7
Others (Please specify)							
______________________	1	2	3	4	5	6	7
______________________	1	2	3	4	5	6	7
______________________	1	2	3	4	5	6	7
In general (Total performance)	1	2	3	4	5	6	7

This is the end of the questionnaire.

Thank you very much for your cooperation.

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